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AVIATION CALENDAR

- Apr. 8-10—English International Symposium, Electrical, Mechanical, Engineering Societies Bldg., 18 W. 59 St., New York City.
- Apr. 8-11—National Aerospace Meeting, Society of Automotive Engineers, Inc., Hotel Commodore, New York N.Y.
- Apr. 10-11—Aeronautical Training Society Annual Meeting, Mayflower Hotel, Washington D.C.
- Apr. 10-19—19th Annual National Forum American Helicopter Society, Sheraton Park Hotel, Washington, D.C.
- Apr. 17-18—Institute of Environmental Engineers Second Annual Technical Meeting, New Yorker Hotel, New York City.
- Apr. 21-23—19th Annual Meeting, Motor Vehicle News and Travel, Mayflower Hotel, Washington D.C.
- Apr. 22-24—19th Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif.
- Apr. 22-24—19th Annual Convention, International Airline Association, Commodore Hotel, New York, N.Y.
- Apr. 24-26—Joint Meeting, International Scientific Radio Union and Institute of Radio Engineers, W. Hotel, Washington, D.C.
- Apr. 28-30—Second Annual Astronautics Conference, sponsored by Air Force Office of Scientific Research and Institute of Aeronautical Sciences, Sheraton Hotel, Denver, Colo.
- May 4-7—Fourth National Flight Test Association Symposium, Park Sheraton Hotel, New York City.
- May 5-7—19th National Symposium, Professional Group on Microwave Theory (Continued on page 6)

AVIATION WEEK including Space Technology

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DIGITAL TIMING GENERATOR, MODEL 206A, FOR AIRBORNE APPLICATIONS is a miniaturized version of Model 201. A Remote Control Box contains Power and Standby-Operate Switch, the Digital Clock Set, and the Time Display. Completely transistorized, Model 206A includes a binary coded decimal system al-

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BY MODEL 203C

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MODEL 206A ANALOG TIMING

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Write for Technical Bulletin T30



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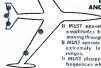
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AVIATION CALENDAR

- (Continued from page 5)
- and Technicians of the Institute of Radio Engineers, Columbus Auditorium, Stratford Square, Shelton, Conn.
- May 12-14: National Conference on Aeronautical Electronics, sponsored by Institute of Radio Engineers, Baltimore Hotel, Dayton, Ohio.
- May 14-16: Spring Meeting, Society for Experimental Stress Analysis, Hotel Wagner, Cleveland, Ohio.
- May 19-23: 17th Annual National Conference, Society of Aeronautical Weight Engineers, Inc., Belmont Plaza Hotel, New York, N. Y.
- May 23-31: 1955 Aviation Writers Association, the Sheraton Hilton, Houston, Tex.
- June 2-4: National Vibration Engineering Conference, Lord Baltimore Hotel, Baltimore.
- June 4-5: Wing Coast Magazine Symposium, sponsored by the Society of Aircraft Materials and Process Engineers and the Magazine Association, Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.
- June 6-12: National Handling Conference sponsored by American Society of Mechanical Engineers, Public Auditorium, Cleveland, Ohio.
- June 8-13: Fourth International Symposium on Electronics and Computers, Colombia, N. Y., N. Y.
- June 10-12: Second National Conference on Military Electronics, Statler Park Hotel, Washington, D. C.
- June 13-15: Special Seminar Program on Radar Systems, an introduction to the solution problem in radar and air search, Massachusetts Institute of Technology, Cambridge 39, Mass. For details, contact: Dr. J. H. D. Smith, Assistant Professor of Mechanical Engineering, M. I. T.
- June 14-20: 11th Meeting, Aviation Electronics and Manufacturing Association, Sheraton Hotel, Boston, Mass.
- June 21-27: Air Transportation Conference sponsored by American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y. For information: S. H. Hume, Jack & Hume, Cleveland 1, Ohio.
- June 14-19: International Symposium, National Advisory Committee for Aeronautics, Ames Research Laboratory, Moffett Field, Calif.
- Aug. 8-10: Special Technical Conference on New Linear Magnetics and Magnetics Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.
- Aug. 10-12: Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.
- Sept. 4-10: International Airframe Show, Columbia New York, N. Y.
- Sept. 5-10: First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.
- Sept. 22-24: 1955 Meeting, Professional Group on Technology and Service, General American Hotel 840 Market, Menlo Park, Calif.
- Oct. 27-29: Annual General Meeting of the International Air Transport Association, New Delhi, India.

AVIATION WEEK, March 20, 1956



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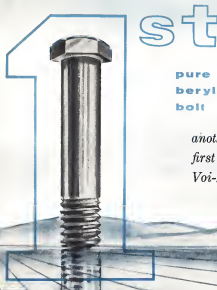
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March 31, 1954



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EDITORIAL

A Sound Security Pattern

We have never been reluctant to plunge our editorial knife into the beds of government bureaucrats—military and civilian—who have used the cloak of heavy military security to further their personal ambition or to conceal what they are doing with taxpayers' money. Over the years we have learned to sail this sort of administrative chicanery at long range. We are proud of the part this publication has played in exposing some of these activities that were unable to survive long in the prison glass of publicity.

We have also been firmly on the record for a more realistic approach by the military to their security problems with adequate consideration for the requirements of legitimate technical security and the American public's need to know how its tax dollars are being spent and the adequacy of the national defense they are buying. Therefore we feel it appropriate to discuss in some detail the pattern of security and working press relations now operating at the Air Force Missile Test Center at Cape Canaveral, Fla. This pattern has been vigorously attacked by some sleazy lobbies for freedom of the press who have seen eye to eye with us on most of the correctness and plain security issues that have emanated from the Pentagon and White House in recent years. But in the case of Cape Canaveral we must take issue with them.

Healthy Public Curiosity

We believe that the pattern developed there by Maj. Gen. Donald N. Yates, Test Center Commander, and his public relations staff headed by Lt. Col. Sid Spear as a sound, realistic approach to the problem that could well be adopted everywhere there is a combination of legitimate military security problems and a healthy public curiosity about what is happening in tax dollar and national prestige.

The security problems presented by the geography and environment of Cape Canaveral were detailed by AMATION WEEK's Space Technology Editor Elvert Clark in a report from the Cape in our Oct. 7 issue on page 28. Nobody will quarrel the fact that the Missile Test Center operations involve some legitimate military secrets. But it is unrealistic to assume that nobody would know when 165,000 lb. rocket engines were being fired in test operations that produced fiery trails and sometimes spectacular explosions for half the population of Florida to see.

Air Force's original policy of having its head in the Florida sand and pretending nobody would notice these spectacular controlled and uncontrolled explosions was an abject failure. The missile watchers established camps on the public beaches, observed firings through

binoculars and photographed missile flights with telephoto lenses and poured out a flood of accurate pictures and inaccurate stories on the activities at the Cape. This policy created nothing useful and because of technically more and incomplete reporting began to mislead the American public its missile development program was a costly failure. Further police methods such as bulldozing sand barriers to screen cameras, erection of barbed wire barriers and halting the working press by two American Airways security guards failed to improve the situation.

Press Briefings Valuable

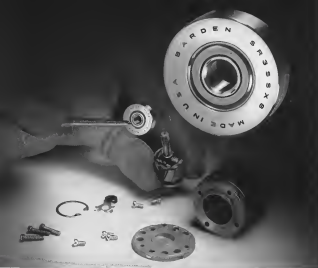
Sometime during the early Vanguard failures a more realistic and sensible policy switch was made. Gen. Yates offered to let it on the line with the Cape press contingent, explaining the legitimate security problems involved and providing all of the useful and technically accurate data possible. A grandstand on the Cape was provided for the press to witness missile firings and was equipped with outside telephones and loudspeakers that relayed countdown information.

We listened to Gen. Yates handle a series of press briefings recently for a large contingent of visiting press representatives from Washington, most of whom had only a vague idea of the problems and purposes of the development test phase of the missile business. In addition to giving them a factual and accurate account of how the Missile Test Center was its business Gen. Yates succeeded in dispelling, for all time we hope, the misconception that operational missiles require all of the complex equipment and procedures required for development testing. We have watched the stories appearing in the daily press since this briefing and notice a much higher degree of technical accuracy and understated understanding of the missile test program than was evident in the catch-on-catch-on type of earlier reporting.

Hopeful Precedent

In our opinion the pattern of USAF working press relations now operating at Cape Canaveral has set a hopeful precedent in the handling of this type of problem. It should be carefully considered by the Pentagon for use in similar situations where unrealistic security policies and legitimate public interests are still clashing and preventing the American public from getting an accurate and technically sophisticated view of their national defense program.

—Robert Hertz



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The Synchro-Bearing, an electronic performance device, was developed by Barden to assure stability in a measure of overall functional quality. A measure of quality control is also used in Barden, the Synchro-Bearing is also used by many leading aircraft and systems manufacturers.

Washington Roundup

USAF, Army Get Moon Roles

White House and Defense Department last week indicated which agency on the nation's first and space program under the direction of Advanced Research Projects Agency.

They include three Air Force moon probe roles and possible two Army moon probes and two or three more Army earth satellites.

The President also will send his plan for a civilian space program to Capitol Hill this week—apparently soon, according to National Aeronautics Committee for Aeronautics at the nucleus of a new agency.

The President ordered ARPA to combine its space projects with NASA, National Academies of Sciences and National Science Foundation and indicated that the new civilian agency will review the moon and satellite projects to see whether they should remain under Defense or go under the new agency's direction.

ARPA already has \$8 million to begin work on the space project.

By official policy was established when ARPA sent its direction straight to the three service agencies to review before they through service channels. A Defense spokesman said the secretaries were aware that ARPA's charter provides for its direct law of transmission to USAF, Army and Navy installations. Recognition of this type of operation will be voluntary and are almost certain to bring parity, if not public, objection from the services.

USAF's lunar probes will use a Douglas Thor as the first stage, Aerojet-General's second stage, Vanguard or Atlas as second stage and a third stage, yet to be developed (AW Jan. 25, p. 26). Vanguard guidance (also may) be used.

Army Ballistic Missile Agency will use modified Jupiter C rockets for its lunar probes and satellite launches. Naval Ordnance Test Station at Inglewood, Calif., was ordered to develop a mid-range ground station system for use in lunar probes, possibly later models than those approved last week. First indications were that that will be developed in NUTS laboratories but not in actual construction.

No timetable was given for these space projects. ARPA Director Roy Johnson said "we would prefer to announce their progress when we are sure of success rather than now, but first public interest was too high. Public apparently will be concerned. These are no indications in the initial announcement that attempts will be made to project on the moon with these first results.

Goal of the program is to demonstrate our capability of exploring space on the vicinity of the moon, in which world data concerning the moon and provide a clear look at the moon.

USAF's work will be directed by Ballistic Missile Division at Air Research and Development Command. BMD had had personnel on the Douglas Thor plant for some time but recently to study the probable use of Thor in space exploration. USAF once had a target date of this April for its first moon shot, but had no intention to go ahead.

Lt. Gen. Donald E. Pett, USAF deputy chief of staff for development, said recently that Air Force could make its first moon rocket launch this year if it gets the go ahead within a few weeks (AW Mar. 1, p. 38).

Defense refused to disclose "details of the moon" projects.

officials, but said useful data could be obtained from as far away as 10,000 mi.

ARPA Chief Scientist Dr. Herbert F. York said moon, test launches probably will be acquired before a probe is successfully placed near the moon.

Space program "contemplates a leap" at the far side of the moon, Defense said, but there is no specific timetable for such an experiment.

Military Assistance

Approximately \$55 of the money spent on military assistance programs this year will go to U. S. manufacturers for the purchase of military Materiel D. Sprague, assistant Secretary of Defense, told the Senate Foreign Relations Committee.

Sprague said there also is hope that an increasing proportion of military assistance can be shifted to military equipment sales. He told the committee that in 1955 equipment sales under the military assistance program amounted to \$79 million in 1955, the sales were increased to \$112 million.

Congress and Space

Agencies on both the House and Senate Special Select Committees on Astronautics and Space Exploration were scheduled last week to make a round of public inquiries. Allen W. Dulles, Central Intelligence Agency director, appeared before the House committee to brief the group in a closed-door session.

Sen. Lyndon B. Johnson, chairman of the Senate Special Committee on Space and Astronautics, advised the President that the committee is opening its doors for business and would welcome White House visits. He said the committee is looking forward to the wholehearted cooperation of the various agencies in what we anticipate will be a joint enterprise.

Johnson said the committee's role is to provide a fact check in too complex to wrap into a single package and added: "It touches into practically every aspect of human endeavor," he said, "and it is going to require an extraordinary effort to bring together information that is scattered in bits and pieces throughout the government and agencies."

Appointments made to the Senate committee last week include: Dr. Glen P. Wilson, coordinator of both oral and written information; Mrs. Eugene M. Callahan, special consultant; Edwin L. Wilson and Ernest R. Wilson, oral and written consultants; and Dr. Homer Jay Stewart, scientific consultant.

CAS Disavowal

Civil Aeronautics Board members have disavowed themselves from the recent letter written to critics and representatives by the Board's chief information officer. William Kluepfer, Jr., answering the press for an hour, said the General Investigator for Interference (ISV) March 24, p. 17). The Board said as a point of record that the action taken by Kluepfer was made without its knowledge and consent. This conclusion admitted that it seemed to them that the press had given the investigation "unwarranted and unbecomingly" treatment of the investigation of the Board's attitude toward airline pilots but also admitted that before the report of the investigation was published as it was.

—Washington Staff

which may be assigned to it by ARPA.

Although Ansa is not prepared to set new law for it to sell in its establishing the annual philosophy, it obviously has begun a careful study of the industries for its contribution to Ansa's progress to far and to encourage an even freer relationship.

"The new command will continue to look to American science and industry for their invaluable contributions in developing Ansa weapons," Ansa said in explaining the reorganization.

"The successful handling of the Jupiter C rocket carrying the first booster-attaching side action is further evidence that this team is meeting the challenges of the new technological age."

While Ansa animals for greater, more developed test weapons, they have now reorganized their organization and capabilities to the use of science, electronics and separate rocket and missile.

Perhaps more significant than these statements is a speech made last week by the Ansa's Vice Chief of Staff, Gen. Louis L. Leventhal, accepting that industry has been a vital element of the military capabilities of the United States at least since 1942 and signing over greater Ansa-industry cooperation.

Although a spokesman for Gen. Leventhal and the speech does not reflect a change in policy, Gen. Leventhal's words are in direct contrast to Secretary Breckin's statement a few months ago that the industry development concept can lead to false starts, wasteful expenditures, and confusion and delay. Such procedures are "costly, costly and time-consuming."

Gen. Leventhal called for even closer teamwork than in the past to build out.

• **Rapid adaptation to military needs of advances in knowledge and techniques which have been made by industry in its own sphere of activity.**

• **Rapid lead time to acceptable form.** Gen. Leventhal and "one training lead time must be placed in the hands of the manufacturer's production lead time. Otherwise, if we were to start training the operator in the equipment only when it was completed, it would reject an unsatisfactory rate in the process of getting a new start into operational use."

• **Expenditure of procurement because of effectiveness in Ansa's budget.** "It is obvious we must be reduced to a degree by close cooperation based on prompt exchange of information."

Gen. Leventhal also said, one of the "misgivings" of the "reorganization factor" and how it has not industrial collaboration time. This has been a favorite theme of Air Force for years in its defense of its "ASAP/military time" concept. Gen. Leventhal at

Recoverable Capsule For Satellite

Lockheed's reconnaissance satellite WS-177L will include a recoverable capsule, the company's annual report disclosed last week. Another Work Item that the main purpose of it will be to determine whether the capsule can be returned to earth at a selected place.

Recovery would be a big savings factor to help annual satellite capsule recovery in the future.

Company's latest reconnaissance satellite capsule is deliberately shown as the booster and would be coupled with a solid propellant second stage. This, according to present planning, would be the second stage of the Delta payload system. Speed to be attained would not exceed 18,000 f.p.s.

Industrial test telescoping of the long-distance factor to advances in the ASAP military transportation and and the industrial industrial action time out needs the freedom "to think of the Ansa industry partnership not exclusively in terms of industrial collaboration in industry."

"The danger (now) is the more we moderate," Leventhal said. "Instead of being held off from us by our allies, we cannot might well strike directly at the industrial U. S. goal. That being the case, the Ansa and the nation must be able to react immediately and effectively."

Thus, state that, even today, the industry-Ansa partnership must be an intimate, continuing reality, based on close cooperation which has its roots in a steady exchange of information, a two-way flow of mutual confidence.

Ansa has \$20 million available, in supplemental fiscal 1975 funds to assist the program, but it did not reveal the amount of the Ansa contract except to say that the program will involve "several million dollars contractually" and become a multi-million dollar program over the next few years.

As various contractors Martin's Orbital Division will be responsible for research, development, reliability testing and production of both the capsule and its ground support. It also will handle engineering, maintenance training, and test services. Birmingham Ordnance District will administer the contract, under ARPA.

Goal is a lighter, smaller, more mobile missile to replace the Redstone. Other changes coming from Ansa's missile reorganization include changes of Maj. Gen. 13 N. Totten, former Redstone Arsenal chief, to deputy commander of the Ordnance Missile Command, promotion of Brig. Gen. John A.

Bailey to commander of ARMA, promotion of Brig. Gen. John G. Shanks to head Army Research and Guided Missile Agency, redesignated White Sands Proving Ground as headed by Maj. Gen. Wilbur E. Ladd and Dr. William H. Pickens, heads the Jet Propulsion Laboratory, operated by California Institute of Technology. All these agencies now are a part of the Ordnance Missile Command.

Slingshot Launching Technique Proposed

San Diego—Proposed for a "slingshot-launched" manned hypersonic glider was confirmed here by Ryan Aeronautical Co. structural engineer Vjekoslav Glasinski, during a discussion on high-speed aerodynamics and structures sponsored by Air Research and Development Command, University of California, Concord, and Rome.

Slingshot method of launching claims that the tremendous amount of fuel required to get a tri-rocket off the ground and bypasses the need for fuel to attain supersonic speed.

Hypersonic glider would be launched from a sled platform on a rail to a mile long Glasinski and rockets on the platform would be fired in sequence to the point through an inclined course two with the glider to provide smooth acceleration to about 500 mph in approximately 25 sec at a time of only 1G. When airspeed, speed is reached, the sled enters in the glider's own power, emitting jet of liquid fuel, oxygen and slanting wings, releasing the glider, releasing the vehicle to the platform.

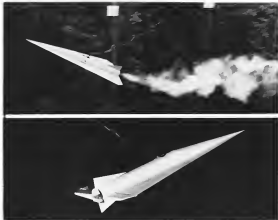
A steep angle of ascent of about 15 to 40 deg would be quickly traversed through a rail tunnel. On its own power, the vehicle would climb to about 100,000 ft, then level off and gain speed in a more gradual climb.

Minimum speed would be attained at break-out of the vehicle at about 300,000 ft when the glider would be traveling 15,000 to 18,000 mph.

Automatic controls would be supplemented by jet nozzles to provide adequate attitude control above 100,000 ft; otherwise the glider would follow a ballistic control after the rocket burns out.

Glasinski estimates that the glider will have about 2,000 mph in the time it develops to 100,000 ft. This would indicate that the most severe heating situation occurs above this altitude in this aircraft, N. J. speed.

Glasinski, who described Ryan's Minuteman method of achieving a paper thin skin to be used on larger, more vehicles to help handle high heat inputs. Minuteman is a needed contribution of Air and associated skin.



National Advisory Committee for Aeronautics hypersonic glider model undergoing free flight test this week at Langley Field (top). The glider is shown in flight, with smoke and debris visible. The model is shown in flight, with smoke and debris visible. The model is shown in flight, with smoke and debris visible.

NACA Tests Model Of Hypersonic Glider





HEALTHY AMERICAN—Cofactor Envision. All species used in studies at McDonnell-P41 and Division 1 building. Multilayer film on plate right (left) is attached. See view, right.



Space Technology

Development of Food-Waste Cycle Goal of Space Flight Researchers

By J. S. Bata, Jr.

Washington—Completely closed ecological systems, automatically duplicating nature's earth processes to produce food and water from human waste, are a primary aim of space flight researchers. These automatic closed-loop ecological systems would represent significant

weight savings over carrying food and water stores which amount to about 15 tons per man per year. The model used at NASA, for example, would require about a year along a high energy trajectory and over three years for a moderate energy space vehicle.

General descriptions of such systems were given at the 20th annual meeting of the Aerospace Medical Association here last week by Dr. C. G. Clark, of the Naval Air Development Center, Johnsville, Pa.

Dr. Clark's proposed ecological unit would provide an answer to the problem of excess water which is produced in the human body's normal metabolic process. This accumulation of excess water, amounting to about 320 cc. per man per day, could actually be eliminated along the problem of long space trips by urine excretion.

Dr. Clark's theoretical system which returns every atom of human waste to the satellite cycle is also considered feasible by Air Force physicians.

All of the organic processes necessary for the closed cycle have been tested, used or left in operation in the laboratory.

Possible errors are:

• Excess metabolic water would be lost in forming carbohydrates in the form of glucose water.

• Solid residue from urine would be used in food for algae or other biological culture producing the proteins, their functions and producing oxygen for breathing.

Dr. Clark presently envisions this food product uses a closed cycle as being glucose water thickened to about the consistency of Fibron by cellulose fiber, a paper thinner than filter paper. The thickener on such an automatic system to make certain that processes upon material is kept out of the food product will be made by X-ray diffraction is Dr. Clark's opinion. The organic net chemical materials would not be adequate.

The closed cycle ecological system will not have efficient components, even though conservation and reuse of the individual atoms will be 100%. Probably 1,000 times the energy (as used in the human body) through the food product will be necessary to operate an automatic system. This energy would be available in space in solar form.

Researching space was discussed by Capt. W. H. Hovens of the Air Force School of Aviation Medicine. His studies have concerned him that a weight saving could be realized by a closed cycle waste-water system on any space trip lasting longer than one week. The two systems offering the weight advantage offer saving water supplies are simple separation of poisonous elements by freezing out the pure water or electro-chemical.

The psychological aspects of space crews depending on such systems for

Environment Limits

Washington—Experimental groups have determined the absolute limits of life supporting environments have passed the following tests:

• One cell animal can withstand more than 250,000 cc. of water to support them to 1,000,000 cc. in long periods.

• Fish will live under 30,000 cc. of water and 7,000 cc. for one year.

• Frogs live under one set of water pressure for half an hour, and breathe twice for one to eight hours. All liquids are the equivalent in being under these conditions.

The experiments were conducted at the U. S. Naval School of Aviation Medicine by Dr. E. B. Bender and his associates.

Final results of the study will help to secure one of the hypotheses now based in the "Antibiotic in Outer Space" report made by the President's Science Advisory Committee last week—that small living particles or animals may be able to survive in space and could drift from one planet.



Sputnik II in Orbit

Sputnik II was photographed with Soviet cos. Optical Tracking Instrument scans at a ground station 200 mi. at the First Missile Test Center, Prineas AFB, 400 mi. in ESE. Lighting was over 6,000 ft. at sunset. It was about 100 ft. at surface while rocket was in full daylight at about 215 mi. altitude. Sputnik II length is between 7444 ft. consists of four stage rocket, dog module and intercomunicational unit.

food and water was not discussed formally at the meeting. Several scientists expressed the belief, however, that side effects could be accepted such as constipation, psychological stress would be one of the most important tasks in preparing man for space flight.

One of the most provocative thoughts "because made at the meeting was presented by Dr. E. Bender of the U. S. Naval School of Aviation Medicine. Dr. Bender feels that the space traveler should be trained against unpleasant aspects in:

• Considering the possibility of a world not centered around carbon and water.

• Considering the variation in life shown to be possible in recent advances in metabolism chemistry which has shed its much light on the present of metabolic processes in all life in the carbon-water world.

Dr. Bender's ideas were echoed by several of the biologists present who believe that the greatest surprises and adjustments that man faces in the next 30 years will be caused by an increase in biological knowledge rather than space flight.

There is a possibility that man, traveling in space or in the upper fringes of the atmosphere might have to pass stacks or circles below his feet in a spacecraft point in order to see objects at a great distance.

W. Miller and Erik L. Lofgren, of the U. S. Naval School of Aviation Medicine, and it was found that the eyes' efficiency drops sharply in a night vision field and that hallucinations occur.

Dual Missile Defense Predicted

Salt Lake City—Ballistic missile defense system and anti-missile development is shown certain to become a reality before it becomes operational in light of technological advances in both ballistic missile design and detection techniques already in the process.

Warning comes from Dr. Richard C. Barmond, manager of General Electric's Technical Military Planning Operations (Tropics), speaking here at the third symposium on Strategic Defense. Dr. Barmond predicted that presently planned ballistic missile defense systems now have to be expanded to provide two distinctly different types of active defense missile systems.

• Forward defense, short range missile to protect Strategic Air Command bases and, hence, bases. This corresponds to Army's Nike Zeus program for ICBM defense (AW Feb 14 p. 64).

• Area defense, short range missile to protect population centers, cities and give increased coverage to strategic striking force.

Dual type missile defense system suggested by Dr. Barmond is comparable to objectives of Air Force World program recently outlined by Secretary of Defense McNamara.

Efficient enough striking to be provided by ballistic missile only warning system now under development in "hush-hush" to launch strategic counterforce.

Dr. Barmond said, and the figure will be "less than five more before ballistic missile systems."

The system requires greatly increased political decision speed of full advantage to be gained from the early war warning system, he said.

Although SAC ballistic missile defense rate can be handled in a certain extent, Dr. Barmond said, there is no

point to designing it to withstand a disaster that is not a disaster. The SAC has a lot of time to be used—possibly in the future—into off-line and off-line systems will be needed to protect it from failure.

Present point defense concept of making reliable low altitude attacks in areas (ICBM), among the strongest to stress on light weight does from low altitude carrying more money, is "pushback all night." Dr. Barmond said, if the attack is very heavy, the point defense missile will not concentrate on these weapons dangerous to the target being defended and to spare war zones.

The requirements for an active missile defense for population centers, targets are quite difficult. Dr. Barmond pointed out, because fire-light can not be fired in a vacuum but enough and because permission is a few seconds before the missile can be fired.

Area defense, active type missile must therefore be designed to operate for extended period despite blast heat and damage and, in the air, as in the case of a missile, but the missile must have high reliability, and must also be hardened against damage, and principal damages must be located near from high targets, unlike the point defense role.

Area defense, missile must strike while enemy vehicle still is in space, which requires use of techniques for coordinating between defense and attack. The system requires greatly increased political decision speed of full advantage to be gained from the early war warning system, he said.

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Explorer III Orbit

Washington—Explorer III was launched by Atlas last week from USAF Missile Test Center, Cape Canaveral, Fla., into orbit approximately 100 mi. A flight path over the ocean was as high as about 1,750 mi. amount of 125 mi. as planned and brought the payload within 125 mi. of the earth, according to Naval Research Laboratory, which also estimated the orbit's life will be 18 months.

Instrumentation on Explorer III is an improvement over Explorer I and will provide more information in long it is in orbit. The new satellite means that closed circuit on the surface and actually in a small time recorder during its orbit. This information is sent to the ground in five seconds by high speed radio.

The Explorer is sent to the ground in five seconds by high speed radio. A low power transmitter continuously sends out radio and infrared signals which can only be received by special equipment. The orbital temperature is reported to the ground by 100 ft. at the same distance over the ground path and on Explorer I is incorporated on the new satellite. The low power transmitter also sends out radio and infrared signals and a count of the count.

The launching vehicle was a Jupiter rocket modified from the Saturn program test. Present period of the satellite is about 117 min.



NAVAL—Ballistic missile and single express satellite 9-6 without defect, replace 22 to out (AFM March 24, p. 17)



Atlas Transporter Positions Missile In Service Tower

Atlas ICES 12-story service tower has gentry cranes, work platforms, electrical and pneumatic air systems for machine and automatic loads. Demountable water system is used to wash missile. Sliding water-proof weather curtains are also used for security. Tower has heavy communications in blockroom, two fire protection systems, emergency escape route for workmen on upper stations, and complete lighting system. Missile is hoisted up ramp on cross-country trailer. Area of missile is then moved to launching device. Cross loads inside, travels to vertical position. After missile is fixed on launcher, trailer is lowered and seven retractable work platforms are positioned. Two 16-man elevator hoist units, equipped. Tower, on transfer table on railroad tracks, is about back 500 ft. for launch. Tower is built to withstand 120 mph winds, can be moved safely in 60 mph winds.



Overtime Policy Eased

Washington-Overtime policy on personnel contracts has been changed by Defense Department to ease administrative burden of contractors and contract for agency under revised Armed Services Procurement Regulation 12-402.

Extensive overtime still is subject to high-level review within a month. Other basic regulations on infinite missile program remain unchanged. The ASPR is to be "given a liberal interpretation in terms of getting on with the job" in any case of doubt on a high-priority program, Deputy Secretary Donald A. C. Quaker said. Services month the new time deadline (4005.45) of last Oct. 1 and Quaker memorandum of last Jan. 16.

News Digest

Swiss order for P-16 home design fight was deferred following crash of the third prototype into Lake Constance. Chiles (ENR) announced (ENR March 24, p. 65) will not be awarded until investigation reveals details. Pilot ejected safely when nose gear malfunctioned heavy is loading approach and he was unable to correct it. It was issued P-16 to crash into Lake Constance.

Republic Aviation Corp. shareholders and creditors returned company's 1955 sales of \$196,214,310 to last year's \$208,607,918. Net earnings were down from \$7,967,445 to \$6,397,518, or \$4.15 a common share. Republic said Defense Department procurement will continue to be left through first three quarters of this year, but adds volume production of F-105 Thunderbolt is expected to begin in last quarter to run through 1959.

Northrop Aircraft Inc. revealed that transfer pattern of higher sales and lower earnings was reversed in six months ended in January. Sales at \$175,024,666 were lower than same period last year, when \$175,727,974 was reported, but earnings rose from \$2,236,157 to \$2,664,169, or \$1.87 a share. Backlog, previously because of increased orders for Saudi missile, rose to \$775 million from \$596 million three months earlier.

Lockheed Aircraft Corp.'s sales and earnings increased in 1957 into a record high of \$668,515,000. Earnings of \$16,488,940 or \$3.52 a share were 50% higher than 1956. Lockheed predicted its missile business in 1958 would increase approximately 1957, to \$330 million.

CAB Fare Probe to Continue Into 1959

Board to resist plea to cut short investigation in its search to determine passenger fare level standards.

By L. L. Doty

Washington—Most optimistic estimates by Civil Aeronautics Board staff members now place date of decision on the General Passenger Fare Investigation at January, 1959, with a strong possibility of a second interim fare increase before then.

Despite a recent bid by American Airlines to keep the investigation through to a finish by June (AW Jan. 27, p. 38), both the Board and its staff members still resist any short cuts and allow the case to run its normal course.

The Board is determined to put an end to general criticism that it has adopted airline rates too 20 years out of the benefit of basic level standards for passengers.

Meanwhile, the swelling critical financial condition of the airline industry is forcing the Board to keep a reinforced eye on current emergency. Staff members on the current emergency presented the Board's action in granting an average 6.65% fare increase in January as an interim relief measure.

In mid-January, the Board took an unprecedented step when it asked the traveling public to sit through the study of the fare case into the second week of January 31.

The move indicated the agency with which the Board is now opening the financial problems of the airline industry and its separate agencies pending set April 1 as the normal deadline for normal reports.

Petition Reaction Divided

Washington—American Airlines petition to the Civil Aeronautics Board to accelerate the General Passenger Fare Investigation is a source of lingering the case to a finish by June failed to win the intended support of the airline industry.

Of the 12 domestic trunklines involved in the investigation, only Continental, Eastern and Western filed supporting letters. Five carriers remained silent on the one which United, TWA and Boeing opposed the American motion.

American, proposed in its motion the elimination of its emergency initial decision on the case and suggested that the Board be ordered directly to the Board for final decision.

On this point, Board said that "as a case is complex in fact, an initial decision should be rendered by one person, i.e., the examiner, who has heard all the evidence and who has the greatest familiarity with the record."

United agreed with American that the case should be given priority treatment but asked that expedition of the case should not "be accomplished by resurrection of the hearing procedures through review of the examiner's initial decision."

Analysis of the report conducted by the Board staff was conducted as an emergency measure without regard to tariffs filed in the interim or the form of that case on the General Passenger Fare Investigation. If the final official disposition of the industry continues to deepen, the Board will again call upon its staff for further studies as a basis for further fare increases.

It is deemed by the American position to expedite the fare case, the Board confirmed this stand by stating that any "necessary interim action will continue to be available outside the framework" of the General Passenger Fare Investigation.

Such action, however, will draw the attention within the Board. It is envisaged with Board experts drawing the American Airlines motion. Member G. Joseph Mattern suggested concerns that any further interim fare increases granted prior to the final conclusion of the general fare case will "prejudice the case."

Mattern admitted to the need for unwavering the financial requirements of the airlines during the investigation but warned of the possibility of strong resistance to higher fares if preliminary hearings during the present investigation. The danger is whether lines can be held without giving the airlines out of the market this has been a source of concern to Board Chairman James H. Doolittle.

Vice Chairman, Glen Conway has consistently recognized the seriousness

of such individual airline. Such action as striking an average on all carriers except those with extremely high rates of return and those with low losses of return have been considered as a method of establishing a common base for the industry.

A completely revised fare structure likely could be achieved in the present Civil Aeronautics Board investigation. A move to change the present fare structure would repeat another formal proceeding which, according to

He added that any attempt to cut short the cross-examination by the Board's experts of an Open House would "possibly be held up" and would jeopardize the independent review of the case which the Board must always uphold.

Purpose of the General Passenger Fare Investigation is to determine finally whether fares should go up or down. The CAB is seeking to set "standards" on which a future fare level can be based by long-term agreement. It has been a lack of such standards that has caused continuing criticism of past practices in rate setting.

And it has been the standards issue that has prolonged the hearing in the investigation thus far. The CAB has charged its staff with setting standards as the only means by which a logical fare level can be reached. The airlines, however, fear that a strong interpretation or application of the proposed standards might trigger regulatory restrictions as they open two.

As a result, both the Bureau of Air Operations and the 12 trunklines have taken almost reflexive positions on the proposed standards so that tests were refused to date in the hearings over a detailed compilation of widely varying opinions of the parties involved. Key areas involved in the determination of standards are:

- Load factors and their relationship to rates of return
- Income tax elements
- Depreciation and residual value of equipment
- Rate of return

To illustrate the complications as solved in setting standards on these matters, staff members are attempting to determine, for example, what rate of return should be based on all airline earnings collectively or on the results

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American Replies to Load Factor Charge

By Robert H. Cook

Washington—American Airlines has issued its "traffic standards" Civil Aeronautics Board officials that the airline has no intent to drop its fare schedule.

Testimony for American in the General Passenger Fare Investigation, Melvin Berman, assistant director of which is planning and forecasting, said the airline's present load factor is lower than the other average generally because its load factor during the 1953-56 period is "abnormally" high due to a lack of equipment and a lower level of competition.

The Bureau of Air Operations has filed an exhibit indicating that American has experienced an increasing load factor since 1953-56. The exhibit shows that American's load factor is higher than the other airlines' load factor during the 1953-56 period. The exhibit also shows that American's load factor is higher than the other airlines' load factor during the 1953-56 period.

Questioning the bureau's interpretation of "traffic density," Berman pointed out that rates were offered in a schedule of airline fare factors. The airline's load factor is higher than the other airlines' load factor during the 1953-56 period.

Part Analysis
Berman said an analysis of past figures shows that some of American's individual schedules that were heavily loaded conflict with a sales and load factor standpoint at 1953-56 have been dropped in the fare case. "In a word," Berman said, "the airline's load factor is higher than the other airlines' load factor during the 1953-56 period."

Capitol's influence in the Washington-Chicago market has not even been asked about by the airlines. American said its rates from fare investigations in 1953, 1955, and 1957. The pattern reflects the airline had a pattern of two and a half day roundtrips on that segment with a load factor of 48%.

There could seriously be a case

Berman cited several cases where American's load factors are again noted separately included between March, 1956 and March, 1957. The period was chosen because it represented a low point, since that month shows the lowest passenger to the competitor's flights.

In this period, American's load factor declined from a high of 68.1% to a low of 61.1% in a month of typical seasonal load factors to moderate load factors.

Capitol Competition
As a case, in part, Berman cited Capitol Airlines' competition with Western Airlines which was investigated between these same months on those routes with the indicated load factor reduction. New York-Chicago, for example, 67.1% to 57.7%. New York-Detroit, down from 70.6% to 52.6%. Baltimore-Detroit, down from 64.6% to 54.4%. Rochester-Detroit, down from 67.1% to 61.1%.

Berman said the bureau that American attempted to sustain its load factor is continuing service but was unsuccessful in the New York-Detroit market. American dropped two roundtrips in the face of light air and a half roundtrip in Chicago.

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AIRLINE OBSERVER

► Watch for Air Line Pilots Assn. to reaffirm its stand to American Airlines that no jet transports will be flown to ALPA pilots unless three pilot seats are shown as assigned to each aircraft with or without flight engineers. ALPA will resolve its problem as a result of a five-year embargo signed by American Airlines last week with Flight Engineers' International covering future aircraft. The engineers' contract also could result in a pilot strike date but have deferred same because of ALPA opposition to an American strike at this time. The American agreement with the engineers could easily change ALPA's position. However, chances of an early strike are slim since a Presidential last-landing board would likely intervene to forestall a stoppage of flight activities.

► Aeroflot's route expansion program (AW March 24, p. 24) was an all-time once again when the airline led a bid to operate Tu-154 jet transports between Prague and Daanawa. The Soviet-owned airline was refused transit rights through Greece by the Greek government.

► Rate of increase of domestic traveling revenue passenger miles continued its steady leveling off in February to reach an 11.9% increase for the month as compared to February, 1977, when a 11.9% increase was recorded. In February, 1978, the increase of revenue passenger miles for the month was 15.5%. Despite the dismal traffic picture, airline stock prices on the New York Stock Exchange remained steady and held close to 1978's highs.

► Incompatibility between an anti-hydrocarbon fuel and a degassing agent is suspected to have been the cause of blistering and corrosion observed on the underside of Comet Mark III in service with the Royal Air Force. There is no evidence of corrosion on Comet aircraft which have not been painted.

► Colden Triangle operations calling for IFR regulations on all sector flights over 9,500 ft. on routes between Chicago-Washington New York will be expanded to cover the triangle routes between Boston New York-Chicago and on all routes along the West Coast. Air Line Pilots Assn. is now polling its board of directors to determine the feasibility of expanding controlled airspace. Most pilots feel the proposal will require unanimous support in three of four IFR sessions.

► Boeing designer O. K. Anderson has developed a larger version of his four-engine An-44 (airplane transport aircraft). The new An-104 model, which is scheduled to fly this year, seats 100 passengers, instead of 84 on the standard An-40. Additional cabin space was obtained by lengthening the An-104 fuselage 5.36 ft. and by placing the seats closer together. Mockup of the An-104's fuselage, together with models of all new Antonov planes, are being sent to the World's Fair which opens in Brussels in mid-April.

► Passenger aircraft requirements, which cost international airlines approx. \$100 million annually, are gradually being eliminated. The next 15 European countries have dropped similar requirements on flights within Europe. Spain and Austria have eliminated the requirement entirely but intend to impose requirements for flights to and from the United Kingdom. In North America, neither the U.S. nor Canada calls for standards on any flight, and several Caribbean area governments are now considering abolition of standards.

► Civil Aeronautics Board is proposing amendments to civil air regulations that will require all aircraft engaged in IFR flight to be equipped with electronic radio communication and navigation equipment that has been approved by the Civil Aeronautics Administration, meets uniform standards for performance and is properly operating under. Purpose of the proposed amendments is to establish minimum standards of performance, maintenance and repair of electronic equipment on civil aircraft in accordance with standards now applying to large aircraft. Board suggests some reduction in operating temperature requirements for equipment used by small aircraft would be made under the revised ruling.

SHORTLINES

► Air Line Pilots Assn. has taken exception to Civil Aeronautics Board findings as to the probable cause of the crash of a Northwest Airlines Douglas DC-12 at New Bedford, Mass., which killed 12 persons last September. Members of ALPA's Accident Investigation Committee reported that numerous air traffic information to the pilots of the plane was the "primary" cause of the crash. CAB and "probable cause of the accident was... pilot attempted to make visual approach by descending prematurely in the approach area with no adjustment to the prescribed outer circle landing criteria previously detailed by existing weather conditions.

► Canadian Pacific Airlines will ask the Canadian Air Transport Board for daily transit rights between the east and west coasts of Canada in part of its proposed transcontinental service. Air Canada will ask for routes between Toronto and Edmonton, stopping at Regina, Montreal and Vancouver, stopping at Toronto and Winnipeg; Montreal and Vancouver; stopping at Ottawa, Sudbore and Calgary; Montreal and Winnipeg, stopping at Ottawa, Montreal and Vancouver, stopping at Edmonton. The airline will use Douglas DC-6B aircraft on the new routes.

► International Air Transport Assn. will split its Traffic Committee into two separate divisions this year. The first meeting will take place in the Caribbean beginning May 13 to deal with offshore traffic landing agreements, restricted airports and traffic documents. The second meeting, to be held in the south of France, will consider all fare and rates and questions of access policy.

► Lufthansa Airlines is scheduled to begin summer fares, weekly Lockheed 10-10C Constellation service between New York and Brussels on April 2nd, in time for the Brussels World's Fair in addition to these flights, Lufthansa will begin daily Constellation service to Brussels from Frankfurt, Düsseldorf and London on April 1. Total frequency of Lufthansa service in and out of Brussels will be 32 weekly. The German airline also will add a new route from Hamburg and Frankfurt to Rome effective April 1.

► Midway Airlines earned 26,479 passengers in February, a 15% decline from February, 1977. The airline was above winter weather in the last two months of 1978 but the last carrier approximately 5200,000 as passenger volume.

Friendly Foe

When a new air defense missile is produced, its "kill accuracy" is theoretical until it is tested against a realistic target under operational conditions. The new, expensive missile target, USAF XQ-4, is one of many "friendly foes" developed by Radioplane to simulate various air enemy threats.

Emphasizing the performance and the appearance of a supersonic, high altitude bomber, the radio-controlled XQ-4 is designed to test the seek-and-kill ability of air defense systems and their missiles.

As major advancements have been made in U.S. Armed Forces air defense weapon systems, Radioplane has designed and developed targets compatible with the advances of these weapons. The XQ-4, for example, not only simulates avoiding maneuvers, but flies up the score of hits and misses when fired upon.

Radioplane, the first to produce remotely controlled target aircraft, maintains dynamic research programs to seek low-cost solutions for tomorrow's defense problems.

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One of GPL's ground speed and drift angle measuring instruments, AN/APN-85, provides basic input to navigation computers which tell Air Force WBs like exactly where they are.

Force WBs like exactly where they are every flight second. GPL auto computers give an instant bearing and continuous display: Ground Speed and Drift Angle. Wind Speed and Direction. Longitude and Latitude. Shorted Course To Destination. Steering Signal To Pilot for auto-pilot.

The systems were developed for the Air Force (WADC). They are the result of an interrelated computerable on-airguide by the knowledge of the wind blowing. GPL's handling of the Doppler effect is an example.

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Air-Ground Telephone

Northwest Orient Airlines, pleased with results of its first air-ground telephone installation, put the service in on a biweekly basis. The service is available in first and is a Boeing Stearman used as a mail plane.

The telephone is mounted on the dashboard panel in the rear of the Stearman's main cabin. Passengers pay about \$1.50, plus regular radio rates for a call and one radio code or reverse charges. Calls can be made to any point in the U.S. as long as the plane is within 175 miles of ground radio facilities of Chicago and Detroit.

Wing Assembly Set For 880 Jetliner

San Diego—Target date for major assembly of the Cessna 880 jet transport has been set for April 18.

Additional aircraft assemblies will be started at three week intervals during the initial buildup with production eventually to be programmed at 40 airplanes per month.

Construction of the 880 will begin with the wing and proceed without the conventional "reengineering" of wing to fuselage. Wings are assembled in six large bays—sufficient for building three sets simultaneously.

After assembly, the wings of airplane No. 1 will be mated—two halves at a time—on June 19 in a Scotchless crane to create lock-proof, integral fuel tanks.

The two wing halves will then be brought together by means of a gravity hoist, and an overwing barrel and underwing cone will be attached. Successive sections of the fuselage will be mated as the wing moves down the assembly line. First flight of the 880 is now scheduled for early 1969.

Airport TV Circuit Posts Flight Data

Kansas City, Mo.—Closed-circuit television system is disseminating schedule information through the passenger terminal here has been installed by Trans World Airlines.

Features RCA Victor television receivers, from 14 to 24 in. in screen size, are located in TWA's operations office and linked at various points to the airport perimeter. Movies board with flight data is picked up in the center.

The screens are situated at various bus levels, restaurants, ticket counters, flight dispatch office, maintenance foreman's office, concourse, concourse office, and ramp office. Screen cost \$11,000 to install.



For fast single-point FUELING AND DEFUELING

Weight saving and simplification of fueling operations are achieved through use of FRI GA-2 Adapter. This Adapter eliminates need for additional fueling points and associated plumbing by providing fast efficient fueling and defueling through the actual refueling probe on military aircraft. The GA-2 Adapter fits on existing MA-2 fueling nozzles and gives positive check on the operational status of actual refueling receiver system during positive fueling then eliminating need of separate check equipment.

Designed and produced by Flight Refueling, Inc. these components are flight-proven for production installations. FRI components simplify assembly and increase system flexibility.

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RE CHECK VALVES for aircraft systems are lightweight (less than 2 lbs.), reliable and extremely versatile. The CRV can be installed easily by using standard hand-tight pipe connections as it may be incorporated into any line (gas ready by inserting a small nut). These light ground valves are pressure-tight and feature low "backing" pressure and low pressure drop. Design series A provided for use with steel fueling lines. Operating temperature range is -45°F. to 140°F.

RE FRIE CONNECTORS — These reliable, flexible pipe connectors with a tolerance for minor misalignment of pipe and valve are made in many sizes and provide fast, easy, and positive connection. They are light weight and pressure tight, and feature the positive of standard hand-tight pipe connections. They have reliability and feature load of over 200 lbs. and have been tested over 10,000 cycles of continuous vibration without leakage. Size 1" to 4" (standard), larger sizes in stock.

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PART: Exhaust casing

CUSTOMER: General Electric (T-28 turboshaft engine)

MATERIAL: A-286, with stainless steel components.

TOLERANCES: .010 maximum gap on mating sheet metal parts prior to welding.

ADHERE TO: MIL 5923

MADE BY: THE BUDD COMPANY, Defense Division

Here is an example of an intricately welded and closely tolerated sheet metal assembly reflecting The Budd Company's engineering and manufacturing facilities. These facilities, used by jet engine and aircraft manufacturers since 1942, now stand ready to assist the minds and the men who are making today's missiles.

THE BUDD COMPANY

Philadelphia 15, Pa.





Third stage rocket of TV-6 Vanguard satellite is lowered into place (left) and lowered (right). Plastic film protects rocket from humidity. In center, propellant tank is stripped of its protective packaging and is hooked for hoisting. Vanguard is shown at right in shield.



Third stage rocket is lowered into place, supported by sling (left) and center. At right, engineers install spider guide on top of the third stage rocket. Spider guide is designed to steady the rocket so that separation from vehicle is straight and accurate.

Technicians Ready Vanguard To Place Satellite in Orbit

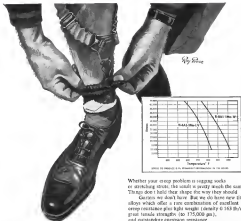
Technicians on site of Vanguard satellite are turned to "on" position (below). The satellite's radio transmitter is now ready to broadcast its signal during orbit.



Test sphere is positioned in vehicle, now ready to be launched into orbit.



Vanguard now ready is lowered into position (left) and lowered (center) by technicians. Nose cone is made of plastic phenolics, it stabilizes vehicle and maintains sphere from heat. At right the gantry crane moves back and the satellite vehicle is cleared for launch.



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In hot and forging stock, there's Ti-6Al-3Mo-4V. In short-time elevated temperature properties are similar to Ti-6Al-4V, one of the most widely used titanium alloys. Yet "8-1-1" offers as much as a tenfold increase in creep strength between 600° F. and 1000° F. This means that for an equivalent stress level, Ti-6Al-3Mo-4V allows the effective operating temperature 250° F.

In sheet stock, there's Ti-6Al-3Mo-4V, which offers excellent formability because of good ductility, bend ductility, and low yield strength in the solution treated condition. Yet this alloy can be heat-treated to strengths of 175,000 psi.

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TITANIUM tank, designed for Afta missile, is rated prior to heat treatment. Tank will hold helium which is used to pressurize the missile's propellant fuel.

Atlas Range Boosted, Weight Cut By Use of Titanium Alloy Sphere

Use of titanium alloy in the fabrication of spherical helium storage bottles for Afta intercontinental ballistic missile is saving Convair engineers more than 700 lb. in structural weight and adds another number of miles to missile's range.

The Atlas (93%) titanium 6% aluminum, 4% vanadium, is produced by Titanium Metals Corp. of America and is fabricated into spherical tanks by Titanium Fabrication, Inc. Ranging from 14 to 24 in. dia., the tanks hold

the helium used to pressurize the propellant. Number of tanks used in each missile was not disclosed.

Engineers said that in long-range missiles it is estimated that each pound of weight saved can add one mile to overall range.

Original studies showed that a 24-in. dia. titanium tank could be made at a weight of 50 lb. The same size aluminum weighed 90 lb. in steel, 125 lb.

Titanium alloy advantages which influenced its selection by Convair include its ability to retain its properties at low temperatures and under high pressure since the helium is stored in the tanks at temperatures to -300° and pressures up to 5,000 psi. Certain resistance of the alloy also was cited, presumably because of extended use with fluids under these helium, which is chemically inert.

Convair's interest in titanium for missile applications grew beyond previous work for the Atlas. In addition to tanks, titanium may be used for engine cases and hydraulic tubing, according to L. W. Stradley, senior engineer in charge of mechanical design at Convair Aerospace Division.



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FROM AN ORIGINAL PHOTOGRAPH BY G. T. KENNEL

Contributing to superb performance . . . engineered and built by Chandler-Evans are the main fuel pumps for Boeing's KC-135 Stratotanker and the afterburner fuel controls for McDonnell's F-101A Voodoo. Both the Stratotanker and the Voodoo are powered by Pratt & Whitney Aircraft turbojet engine.

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SYSTEMS • CONTROLS

Satellite Comparison

VANGUARD EXPLORER I SPUTNIKI SPUTNIK II

Weight in orbit, including fuel stage	50 lb. plus	30.8 lb.	184 lb.*	1,130 lb.*
rocket case	215 mm	214 mm	96.2 mm	305 mm
total stage	2,515 mm	1,800 mm	146 mm	1,216 mm
total payload	497 mi	218 mi	245 mi	150 mi
estimated lifetime	Five to 10 years	Several years	Remained in orbit 2 months	6 months

* Fuel stage weight can vary and is included

ICBM Effectiveness Depends on Support

Los Angeles—USAF's ballistic missile can count dependent upon logistic support that can, anyone ever doubt, Maj. Gen. Ben J. Funk, chief of Air Materiel Command's Ballistic Missile Office, told San Francisco Valley Chapter of Commerce.

Gen. Funk attributed this dependence to the inherent weakness that is latent in missile warfare and extreme reliability demanded by his of human control at the moment of launch. Reliability of the big missiles calls for new concepts of supply and servicing. Third element of missile logistics is the greatly increased rate of general support compared to aerial munitions. He said that about 50% of total maintenance effort will be expended in ground support equipment. The Atlas ICBMs at a launching rate will account for less than 10% of the total cost and spare parts will be less than 10%.

Electronic, data processing equipment and telemetry and transmitter components will be vital to control the vast logistics enterprise. Many said of the missile system is a big computer operated by the Ballistic Missile Group and located at San Bernardino, Calif., which will be linked to the logistics communication network to provide guidance, weapons storage sites and contractors. All innovations will flow through this system. Computer is expected to be operating this fall.

Gen. Funk emphasized the role of small business and subcontracting to missile development and production. He pointed out that of more than 54 billion paid to ballistic missile program, \$207 million, or almost 21% was passed on to small business subcontractors. The overall national figure for small business subcontracting participation is 12%. The ballistic missile business figure is expected to rise as progress from development into production continues. Almost 40% of money spent on Atlas and 40% on Titan has gone to subcontractors. Rockwell International reports that 540 million

or more 10% of the amount of the missile contracts for Atlas and Titan contracts went to first tier subcontractors. Of this \$11 million was passed on to second, third and fourth tier contractors. Businesses employing less than 50 people received 70% of the total, 22% went to companies employing 50-100 people and 7% went to those employing 100-500 people. Rockwell has a total of 4,500 small business subcontractors.

Douglas Aircraft reports that over 25% of the amount of the Titan contract went to small subcontractors. Ford, also subcontractor, said that of a small business effort to make small firms in their designs with prime contractors.

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ENGINE crew starts on second Lockheed project Electra at Burbank, Calif. Right line. Each engine develops 1,750 hp.

Electra's Goal Is Short-Medium Market

By Irving Stone

Burbank-Lockheed Aircraft Corp. is refining an its Electra transport's combination of lightest engine and passenger to better the economics of the U. S. air travel segments which carry about 75% of airline traffic—the short to medium range runs.

To meet this key role in airline transportation the Electra project, now working and scheduled for initial delivery to Eastern Air Lines in September, is designed particularly for:

- Weeklong service in a seven-flight-per-day routine, backed by an over 400-mile cruise capability.
- Low initial and operating costs.
- Fast servicing and maintenance, precise factors in keeping plane flying and in short turnaround time.
- Superior close-ground flight characteristics and range economy.

electricity and range economy.

Setting its design sights to hit both these aims in all three and supporting objectives, Lockheed engineers have worked up more promising detail analysis and test in the evolution of the Electra than with any other Lockheed transport.

Traffic Analysis

When the upcoming jet transport era begins to take shape, extensive analysis by Lockheed showed that 75% of the air traveling public was "commuter" type in the short to medium range segment. This was a big segment of the market and Lockheed designed for it. General concepts began to jell in late 1954. Fanning of design was prompted in large measure by

American Airlines' design competition for a short to medium range plane. American made it clear in mission description that the plane would have to go "into the hinterland"—to small towns with relatively short runway airports. Another consideration was that the vehicle would have to operate with a low load factor—40% to 50%—and make money in at least break even. Cost loaded with that was the attainment of blood-suck, speeds in the general area that the public had been led to believe would be available in this next round of commercial transport.

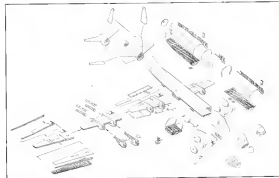
For its broad target, Lockheed picked an over-400-hp engine speed. Superimposing this, it was clear that the plane would require rapid acceleration and deceleration, good low-speed maneuverability, short taxi-out and landing runs, minimum stopover and turnaround time.

Analysis of these requirements, in conjunction with a study encompassing the entire family of jet-type engines and large and small aircraft, prompted selection of the present powerplant. Lockheed believed that this engine possessed desirable operating characteristics in the ground and near the ground, together with a more-than-reasonable cruise speed, considering that the plane would spend a relatively small portion of its operating life in cruise. The project also was prompted because of its high takeoff thrust, high approach and landing drag, and relatively low specific fuel consumption. In the short-to-medium haul, Lockheed engineers determined that flight would frequently be between 5,000 and 15,000 ft. and in this regime the propjet demonstrates

AERONAUTICAL ENGINEERING



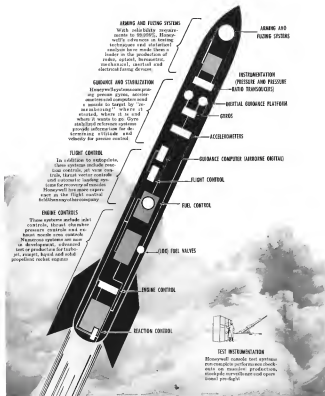
Lead Electra on final assembly line is expected to begin proving program in April. Second, fourth aircraft on line on the Lockheed Va Line.



MINIMUM bulk, light engines, weight-saving design: gross empty weight of 56,000 lb., gross gross takeoff weight of 125,000 lb.



ELECTRA cabin body has constant inside diameter of 120 in. for ease at the obvious seating.



ARMING AND FUSING SYSTEMS

With solid-state measurements to 99.999%, Honeywell's advances in testing techniques and statistical analysis have made them a leader in the production of radar, optical, inertial, mechanical, inertial and electrical fusing devices.

GUIDANCE AND STABILIZATION

Honeywell systems comprising gyroscopes, accelerometers and computers read a missile's target by "zero-measuring" where it started, where it is and where it wants to go. Gyro stabilized reference systems provide information for determining altitude and velocity for precise control.

FLIGHT CONTROL

In addition to autopilots, these systems include pressure controls, jet valve controls, thrust vector controls and automatic landing systems for recovery of missiles. Honeywell has more experience in the flight control field than any other company.

ENGINE CONTROLS

These systems include oil controls, thrust chamber pressure controls and exhaust nozzle area controls. Numerous systems are now in development, advanced test or production for turbojet, turbofan, liquid and solid propellant rocket engines.

ARMING AND FUSING SYSTEMS

INSTRUMENTATION (PRESSURE AND PRESSURE RATIO TRANSDUCERS)

VIRTUAL GUIDANCE PLATFORM

GYROS

ACCELEROMETERS

GUIDANCE COMPUTER (AIRBORNE ORIGIN)

FLIGHT CONTROL

FUEL CONTROL

(JIC) FUEL VALVES

ENGINE CONTROL

REACTION CONTROL

TEST INSTRUMENTATION

Honeywell conducts test systems non-destructive performance checks on machine production, simulates environments and operates pre-flight.

How many brains make a missile?

Control systems are the brains that guide, control and explode missiles. Honeywell can build any of these integrated control systems or sub-systems.

Honeywell is now developing and producing systems, sub-systems and components for the following missiles: Skyraider, Honest John, Aurora, Corporal, Thor, Redstone, Wasp, Little John, Falcon, Vanguard and many other applications. This broad experience in missiles, as well as a solid background in rockets and aircraft systems, makes Honeywell the logical company to aid you in your airborne control problems. Contact Minneapolis-Honeywell Military Products Group, 2750 Fourth Ave., South, Minneapolis 8, Minnesota.

Honeywell





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For a world of design made
lighter and stronger than ever before

88-PASSENGER STANDARD INTERIOR—plus 60 baggage seats



98-PASSENGER CUSTOM INTERIOR—plus 60 baggage seats



STANDARD interior aisle width is 17 in., seat width 18 in. Custom only width is 25 in., seat width 20 in. between arm rests

very economical fuel consumption. Also, the project would give a higher percentage of scheduled equipment by reason of its economic building ability, in comparison with a more rigid Lockheed planform assumed that there is no single passenger than one who is put down at an alternate airport 200 to 400 mi. away from his destination.

Everglades design was Atlanta 565 D. Location of difficulty with induction going in any project engine has been noted thoroughly in the industry. Lockheed considers these details completely unimportant. Even today, the going is an extension of reliability and experience price up in

20 years of operation with period on the airbus. Only unique feature of project reduction going in its greater sleep-down, but that point no problem. Lockheed engineers say

Economy Goal

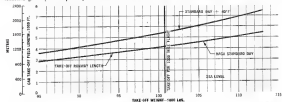
Lockheed's target was to achieve lowest cost per seat mile in the short-to-medium haul category, roughly approximating 115 to 130 mi. General approach was to keep size and weight as low as possible.

After considerable discussion with airlines an agreement to meet demands of the short to medium haul, Lockheed established a 60-passenger

custom (first class) configuration, and up 55-90 passenger (standard). In total, Lockheed's short (104 ft 8 in.) fuselage length accommodates 15 rows of seats by location of pressure bulkhead further aft and carrying full width of cabin farther forward.

Long experience showed Lockheed that the mid-diameter of its Constellation transport was optimum for comfortable base or first class accommodations. Four abreast would be considered lower accommodations, five abreast seat dimensions would have to be slightly compromised in those in percent short line) than current transport.

Electric cabin body was then de-



TAKEOFF field length for standard 60 (CAR compliance) is 4,890 ft. for 100,000 lb. initial weight, necessary for 1,000 mi. flight

NEW LOCAL SERVICE VISCOUNT

GREATER PROFIT POTENTIAL FOR SHORT-SECTOR HIGH-FREQUENCY ROUTES



Low operating costs

On short-sector, high-frequency flights the new Local Service Viscount will provide the lowest operating costs of any post-war aircraft in this category. Design refinements

enable possible exceptionally low break-even load factors on local service operations. Vickers engineers will gladly make a complete cost analysis of your routes.

Proved popularity... big capacity

Since its introduction to American service in 1955, the Viscount has firmly established itself as the most preferred of all modern airliners. Because of its listed standard hours, altitude and speed, the jet-prop. Viscount has proved its

status as a mileage of 30% for 37 airlines worldwide. The new Local Service Viscount will comfortably accommodate 34 to 40 passengers. In either configuration there is ample space for passenger luggage and mail.

Dependable, economical Rolls-Royce power

The Local Service Viscount is powered by four performance-improved Rolls-Royce Dart 506 jet-prop. These engines have demonstrated their outstanding ruggedness and reliability under operating conditions similar to those of local service operations. The Dart 506 engines are uncom-

pared for constant, low oil maintenance oil hours between overhauls (T.O.C. reports appear for 1000 hours—with current test figures, being run to 2000 hours). They give the Viscount exceptional rates of climb and cruise performance and a cruising speed of 308 mph at 14,000 feet.

Fast intermediate servicing and terminal turn-around

The Local Service Viscount can be operated as easily as up to five 100-mile routes—without refueling and with a minimum of ground handling. Provisions are made for fast water-wing pressure refueling at terminal points (covering fueling points are also provided). Low ground requirement is needed and valuable time is saved by the Viscount's integral, hydraulically operated stairs. Further storage are secured in the regions easily

regulate water-refueled at intermediate stops.

The 14 engine can be kept running during intermediate stop-overs—thus ensuring ample power for restarting the engine. If heavy stopovers are required, ground refueling is still possible because of excellent battery capacity. Stacks on numbers 1, 2 and 3 engines prevent interference of proper ground rules, quick on-and-off loading of passengers as the left side, right as the right.

Local Service Viscount means Jet Age growth for you and the communities you service!

By saving time and money in fuel—and by introducing Jet Age service concepts to the Jet Age—this is the "Jet Age" that the Viscount will open up, in increasing new business traffic that means increased growth. This growth will benefit not only local carriers, but the areas they serve—areas that demand the opportunities that come with the best and most modern service with

service the Local Service Viscount is tailored for highly economical operations—and because its payload capacity is sufficient to absorb future growth—it is the ideal airliner for local service routes today and tomorrow!

For information, contact: Christopher Clarkin, I. F. representative, 16 Westcliffe Plaza, New York 36, N.Y.

FROM THE WORLD LEADER IN JET-

PROP AIRCRAFT...

VICKERS LOCAL SERVICE VISCOUNT
POWERED BY FOUR ROLLS ROYCE DART ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LTD., WYVERNIDGE, ENGLAND - MEMBER COMPANY OF THE VICKERS GROUP



Photo of the ATLAS ICBM at Cape Canaveral, Florida, June 15, 1957.



Flight Control for the ultimate weapon

Three Honeywell Rate Gyros, Type JRT, provide accuracy with precise three-axis directional stability and are currently being supplied to the ATLAS missile program.

The Type JRT is a highly accurate precision instrument for measurement of absolute rates of rotation in aerial space. Vibration damping is electro-mechanically controlled to minimize a constant damping rate over the entire operating temperature range of -65°F . to $+125^{\circ}\text{F}$.

This new Honeywell Rate Gyro is designed especially for flight control of missiles and flight instrumentation in missiles and aircraft where severe ambient conditions prevail... and in the same way where low threshold, maximum hysteresis, excellent linearity, high natural frequency and ruggedness are essential.

Honeywell inertial components and engineering experience are available to assist in the solution of your Gyro system problems. Write for Bulletin JRT... Minneapolis-Honeywell, System Division, Dept. 18, 1400 Soldiers Field Road, Boston 15, Mass.

Honeywell

Military Products Group

DESCRIPTIVE DATA

- EXCELLENT LINEARITY: 0.01% of full scale
- LOW HYSTERESIS: less than 0.1% of full scale
- LOW THRESHOLD: less than 0.01 degrees/second
- MICROFLEX PROOF: Rockwell resistance type giving excellent vibration and high g-tolerance characteristics
- FULL SCALE RATE: Up to 1000 degrees/second
- FULL SCALE OUTPUT: Up to 10 volts
- RUGGED: Withstands 100 G shock
- VIBRATION: Withstands 15 G to 2000 cps.
- SIZE: 3 1/2" diameter 4 1/2" long
- WEIGHT: 4 lbs.

was condition. Loss timing and pointing time also results from improved maneuverability, inherent in the response of engine-propeller combination in both acceleration and deceleration.

Saving in time thus may amount to only one or two minutes for takeoff and landing situations, but multiplied by an average of 10 or 12 hours per day, it adds up to a sizable economy, considering related factors such as reduced engine time, less flight crew time, fuel savings and reduced maintenance cost.

Flights can be operated at various altitudes dictated by weather or traffic control conditions with small effect on flight schedules or operating costs, Lockheed says. At 2000-ft. flight distance, if flight plan altitude is changed from 15,000 ft. to 5,000 ft., there is an improvement in block time of 1% and the increase in operating cost will be about 1%. If it is necessary, to fly at 20,000 ft. instead of 10,000 ft. for a 250-mi. trip then block time is reduced by 1.5% but operating cost is increased by 0.7%.

For 250-mi. flight distance, if flight plan is changed from 10,000 ft. to 5,000 ft. cruise, block time is improved by .4% but operating cost is increased by 1.6%. If the change for the same trip is from 10,000 ft. to 20,000 ft. altitude block time deteriorates by 1.5% while operating cost is increased by 1.2%.

Average Flight Distance

Estimate of flight distance, average for Puerto Rico route service will be in the neighborhood of 200-250 mi. Initially, Electro will be used for some of the "blue ribbon" flights, reaching relatively long distances, so that average flight length will be high in the early part of Alaska service. Eventually the distance will be reduced toward the 200-250 mi. flight length as the pace jet transports are put into service for medium-long range service.

Flight operating costs submitted by Lockheed for standard 25 passenger Electro, assuming zero wind condition, 141 cents per gallon fuel cost 15 cents, maintenance time and using 95% Air Transport Association method, are 7.5 cents per minute for 100 mi. flight distance, 1.91 cents for 200 mi., 1.72 cents for 300 mi., 1.57 cents for 400 mi., 1.5 cents for 500 mi., 1.32 cents for 1,000-mi. flight distance.

Takeoff field length for standard jet, based on Civil Air Regulations requirements assuming no engine failure at the most critical point in takeoff run and propeller system's failure, is 4,170 ft. for takeoff weight of 200,700 lb., necessary for 1,000-mi. flight. The standard 440-ft. hot day distance is 5,610 ft. At maximum takeoff weight of 115,000 lb. standard day and hot day takeoff lengths required



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Lockheed RB20 Selector Valve, a pneumatic solenoid-actuated valve for an air-to-air missile, conducts four 3-way actions in one, provides precision flow control, rapid response.

Memo: to missile men looking for dependable components

Meeting ultra-critical valve requirements in missile applications demands a rare combination of creative engineering and specialized manufacturing skills. To these must be added precision equipment, rapid quality control and long experience with metallic and plastic components. Tactair has all of these essential

Case in point: the Tactair ultra-critical, pneumatic multiple in-flow valve with precision flow control—specifically designed and built for high dependability in a new air-to-air missile. This valve is designed to flow over a wide range of pressures—from 500 to 3000 psi. Controlled response is extremely rapid—30 milliseconds. Valve is very compact and light in weight for a complex unit of this type—only 5.4 pounds.

Result: a high order of dependability under extreme environmental and operating conditions. Unique design gives accurate control of flow over a wide range of pressures—from 500 to 3000 psi. Controlled response is extremely rapid—30 milliseconds. Valve is very compact and light in weight for a complex unit of this type—only 5.4 pounds.

Remedy: on standard or special components, we welcome the opportunity of assisting you with your next precision valve problem. Every job we do is done on a guaranteed basis, a fact born that way for 18 years. Tactair Valve Division, Aircraft Products Company, Bridgeport, Pa. K40000 3-1000



CONTROL, SELECT, BRANE, RESTRICT, CHECK... with **TACTAIR®**

are 5,470 ft and 7,550 ft, respectively. Clovis has contributed an all-out effort to build the highest degree of accuracy and repeatability into the Electro, proceeding as the process that these lathe are among the most critical for airline operation.

Lockheed's philosophy was that serviceability and maintainability would have to be designed into the Electro from the start. Conceptor's master design and equipment design still includes fastest airline engineers who, from the beginning of performance design, actually looked over the shoulders of Lockheed transport designers.

Coupled with this approach, the main-

Cost Control Factor
Cost control, starting right in engineering, has been much more on an important factor in Electro design than in any other Lockheed project. Price of parts is under \$1 million generally, depending upon extent of customer request and quantity ordered. That price is considered relatively low in today's market and also because of Electro's strong support.

Electro has been planned and tooling for 101 per month production rate. This tooling approach means that fewer machines and less rework time will be used to produce the aircraft.

Production rate is planned on side of 400 aircraft; to date 144 have been sold to 11 airlines. Like any other major part aircraft enterprise, the 400 figure is a target fixed at the beginning of the program and is the basis for all planning, tooling and production line facilities. In recent, it is a risk assumed by the manufacturer, but it lowers the unit cost per plane.

Tight Scheduling
Usually careful detail scheduling has been imposed into engineering, purchasing and manufacturing to ensure meeting technical and delivery commitments.

On-time delivery is vital, because except of these planes by airlines has been timed for flying into the jet transport era to facilitate crew maintenance and training, and to allow airlines which are still getting the big subsidies (such as American Airlines, Eastern Air Lines, National Airlines, KLM Royal Dutch Airlines) to avoid overloading individual airlines and permit them to pick up extra capacity with the program. From flight of first Electro was approximately 35 days ahead of schedule.

For additional assurance that there will be no delay in delivery, Lockheed is conducting an extensive operational "swagat" program. It will have more test planes in the Electro program than in any of its previous transport developments. The roll-in schedule for Electro plus the Electro's 144th Navy Super Constellation with Electro's AN-500 pre-production version (AN-500 Oct. 14, p. 95), as well as a 1965 Constellation with Allison propeller engines

installed in No. 4 position.

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tenance group composed a substantial cross-section of airline using a wide range of equipment to find out what their current problems were. This gave a detailed picture of what was to be avoided and what was to be stressed in the Electro design for serviceability and maintainability.

For another check, before primary design was under way, Lockheed's maintenance design group established target tests for installation and removal of equipment. These figures were considered and served as general rules for maintenance. As installation drawings progressed, they were dictated by the maintenance design group.

Reliability HISTORY of the H-3 Gyro

SCALE 1:1

TORSION WIRE TEST DATA
Period to 12 Apr 59
Engineer - E-3

Purpose of Test:
To verify computations indicating infinite torsion wire life under severe conditions of vibration and shock.

Procedure:
Modified Moore rotating beam fatigue test, using production parts (torsion wire and gimbal) simulating fatigue stresses that would be encountered in extreme operating conditions.

Results:
Fatigue Tests run in air without benefit of reduced stress levels afforded by damping fluid in a complete gyro assembly.

Conclusions:
Experimental verification of computations indicate infinite torsion wire life.

Load (lbs)	Revolutions to Failure	Revolutions to Failure
1.0	100	1,000,000
1.5	40	1,000,000
2.0	20	1,000,000
2.5	10	1,000,000
3.0	5	1,000,000
3.5	3	1,000,000
4.0	2	1,000,000
4.5	1	1,000,000

*Test discontinued with wire still intact; Torsion wire Life expected to 100,000,000 revolutions in 100,000 hours.

Military Products Department

AMERICAN-Standard
DETROIT CONTROLS DIVISION

100 Morse Street, Norwood, Massachusetts 01955



TUCKERTON poplite block is broken and two blocks and main piston spacer, roller, and actuating system. Spacer also contains electric landing system.

extreme if target trees could be met. This check was further evaluated as functional exercises.

In addition, component and system modifications for representative and actual costs are being checked on the test production Electro Chicago will be necessary work and checked out on four more Electros, after which the sole target trees should be resolved.

Service, Maintenance Criteria

Factors established as prime requisites for maintainability and serviceability were simplicity, reliability, interchangeability, safety and accessibility. Degrees of accessibility for all components in level in a system of priority related to the degree of servicing anticipated and component service life.

One of the key observations was that too much maintenance on today's aircraft had to be performed from inside the airplane. To increase this, design for external maintenance was stressed using "service center concept" which permits the concentrated equipment grouping easily reached from external locations. This allows specialized maintenance personnel to work on concentrated areas on equipment requiring their particular skills.

Traverse shooting procedures are simplified and access is afforded without removal of landing or cargo. Electro service center include:

- **Hydraulic center**, located just off of rear wing beam, accessible through large door in fuselage bulkhead. It contains such items as electrically-actuated pumps, filters, reservoirs, selector valves and alarm power booster. Use of electric

actuation pumps minimizes line lengths normally involved when pumps are engine mounted and permits check-out of hydraulic system with engine inoperative. Manifolds located directly in the hydraulic service center are used to plug in components normally line connected. This minimizes leak potential. Manifold connections are designed so that leaks cannot be made incorrectly. Manifold has several considerable weights in comparison with line operating and has eliminated 75 external connections in one hydraulic installation.

- **Electrical service center** is located far rear of fuselage in fuselage belly. It concentrates on a single area each circuit as the main power distribution generator control equipment, in place of separate control equipment. This arrangement minimizes line lengths to and from periphery. Location of electrical and hydraulic service centers on opposite sides of the center section may be put a maximum distance between electrical leads and hydraulic leads with that flexibility potential.
- **For overhauling service center**, located just forward of electrical center also has separate access door and can contain such items as components, in-circuit cooling units, recirculation fan, main system filter, valve door electric heater and electrical control package.

Other details of Lockheed's emphasis on easy maintainability and serviceability include these provisions:

- **Access**, attained by four quick-release latches, is gained at top for access to weather radar and associated components. With radome open, four

down gate complete access to conduct external and back of instrument panel.

- **Package plug-in-type** system components have been used wherever possible. In some instances, this approach will save as much as three hours of maintenance time. Lockheed estimates Example is in fuel system, where four thrust components such as pumps, valves, quantity probes and dip sticks are removable from outside of tank without necessity of draining fuel.

- **Main and nose landing gear** incorporate mechanical blocks which physically block actuation of the system that to eliminate possibility of inadvertent activation while plane is resting on gear. In addition to serving as a safety device, this arrangement saves aircraft's time involved in making safety pass after each landing. One solution that Electro on normal schedules may make one landing per hour average, this saving will cost at least one half hour per day in mechanics' time, possibly will cut down on number of ground crew required.

- **Landing gear axle** has been designed with internal threads for mating with wheel retaining nut. This eliminates possibility of damage to thread as in former practice when wheel bearing nut was screwed across external threads in wheel rim area. Damage to these external threads meant damage at least, and possibly replacement of one gear axle and wheel assembly.

- **Nose landing gear** service is restructured to give free overhauling action as soon as towbar is attached. This eliminates danger, in former practice, of damage to nose wheel if mechanic would forget to disconnect sensor. Disconnection of towbar automatically puts nose gear back in locked position for steering.

- **Quick trouble-shooting** arrangement in wiring block at system uses a single push to test check point to detect cause of system leakage in various levels. This check can be performed quickly at preflight and, in consultation with system wiring, indicates general location of excessive load.

- **Rigging adjustments**, except in motion control system, are limited to system terminating points. This eliminates intermediate adjustments with attendant possibility of incorrect rigging. Rigging pins are used at terminal points to speed adjustment and eliminate spread rigging techniques. Similar rigging provisions also apply to engine controls.

- **Safety wire** and service pins have been eliminated wherever possible in favor of self-locking nuts and self-locking threaded inserts in structure, equipment, engine and propeller. This is intended to save considerable time normally lost in maintenance and internal operations—estimate is that as

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Characteristics:

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DESIGN REQUIREMENTS: Operating 3000 psig.
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Burst 5000 psig.
(Actual Burst 8000 psig at +300" P)

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overall of one engine and propeller about 39 inches will be used.

• **Unusually large number of access doors (188)** generally are equipped with quick-opening latches to speed hot and periodic servicing. Latches used for pulling one piece of equipment to give access to surface. All through wing leading edge is hinged, faster access to specific areas is provided with doors measuring 6 x 8 in.

• **Complete interior consists of pre-treated panels** which can be quickly swapped into place as rubber shock mounts. Thin fasteners complete change of interior color or trim schemes, allows quick individual panel replace when damaged, permits individual panel removal for access to structure for inspection. Panel access also allows access to structural radials leaving elements for cabin, which operate at low watt density for maximum life. Cabin wall has protective film adjacent to fuselage skin, followed by 1/16-in. thick Fiberglas blanket adjacent to an aluminum alloy core honeycomb panel which contains the heater elements. This is followed by a Fiberglas sheet covered with heat insulation for cabin interior. Radial heat exchangers in cabin floor suit area as heater and stronger than those in walls to compensate for stress factor. Electrical heating panels are also installed under cargo compartment flooring.

Here, heating elements are held in a single metal sheet for shock-absorbing metal glass cloth. • **Relocation of anti-collision rotating beacon** in another example of structural rearrangement maintenance replacement, but more is expected to see considerable modification of bulb replacement is required. Normally this beacon is mounted on vertical tail, when it must be modified by long fuselage or frame. On Electro, beacons are on top and bottom of fuselage in area of rear access door, so that top bulb can be replaced easily from inside cabin and bottom bulb from ground.

• **To minimize ground-support equipment**, in fact minimizing ramp congestion, Electro's frame seating system, its hydraulic system, folding stairways and air cabin heating system all use electrical power which can be supplied from a single electrical ground power cart or ramp connection. This is designed to cut wiring connecting and ground maintenance equipment such as wing and tail gear (used for Con. children and DC-7s) and water and water servicing equipment.

• **Aluminum modified 801-DH (except engine for improved maintainability in airline service, in accordance with Lockheed specifications.** Major structural is stable to prevent turbulence and because no auxiliary wing engine installed on the aircraft. In addition to

Electra Basic Data

DIMENSIONS, AREAS

Wing area	1,300 sq. ft.
Wing span	88 ft.
Wingspan length	104 ft. 6.5 in.
Fuselage inside diameter	825 in.
Height over tail	32 ft. 8 in.

STRUCTURAL DATA

Takeoff structural design gross weight	121,800 lb.
Landing structural design gross weight	95,650 lb.
Minimum zero fuel weight	80,910 lb.

(In Electro for which additional weight can be placed this figure will be raised to 96,900 lb., providing payload increase of 5,040 lb., with manufacturer's weight empty increase of 50 lb.)

Land maneuver load factor	Positive 2.90 Negative 1.00
Maneuver load gross load criteria	50 gps. up to 124 kt. EAS
Design limit diving speed	405 kt. 1.6M above 8,000 ft.
Design limit level flight speed	Mach .711 above 124 kt. 1.6M below 12,000 ft. Mach .615 above

WEIGHT SUMMARY (AS PASSENGER STANDARD)

Weight empty	86,120 lb.
Operating equipment (detail)	9,215 lb.
crew and crew baggage	955 lb.
passenger and reserve equipment	1,950 lb.
steps equipment	360 lb.
refuel fuel and oil	104 lb.
consumables	295 lb.
Operating weight	99,610 lb.
Fuselage (detail—space level)	21,055 lb.
passenger (15)	14,325 lb.
baggage	1,400 lb.
steps	3,270 lb.
Reserve fuel (15 gal)	6,200 lb.
Landing weight (with above reserve)	88,710 lb.
Design gross	111,800 lb.

ENGINE DATA

Length	145 in.
Width	37 in.
Height	35 in.
Weight	2,740 lb.
Fuel	8,000 lb.
Takeoff	3,710 rpm S. L. fuel 545 lb./hr./cyl. 3,375 rpm
Maximum continuous	S. L. fuel 545 lb./hr./cyl. 3,305 rpm
Climb 900 max. rated temp.	S. L. fuel 568 lb./hr./cyl. 3,305 rpm
Climb 900 max. rated temp.	S. L. fuel 592 lb./hr./cyl. 3,305 rpm

facilitating maintenance or replace work, this will be a considerable aid during periodic maintenance or detrainment of individual panels may be extended.

• **Engine zero refueling gas line**, also can be removed with engine installed. • **Complete propeller power** can be removed and installed in approximately two hours. Left by attaching to top of power egg is fitted with a Lock head designed, strong incorporating an automatic variable means of growth post faster to eliminate time consuming

handing adjustments, in addition to handling power egg lift bar and skid also will fit basic engine.

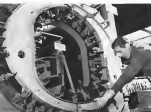
• **Maximum propeller functions** can be checked directly from cockpit. This includes blade angle following, feathering, securing, negative torque system, hydraulic system (with engine operation in static).

(This is the first of two articles in the Lockheed Electro. The second will appear in next week's issue.)



ELDER press with 3,800 lb. pressure (left) is of Swedish design, manufacturer. Cast-iron belt vertical copying mill is at right

CENTER section frames are drilled in fabric at left. Integral tank is dressed partly by mass fudge conversion frame (right).



MAIN fuselage frame in powerplant section is assembled in jig at left. Wing leading edge is assembled in bench jig at right.

INTEGRAL tank section feed assembly (left) shows skin plating being perforated, drilled. Landing gear bay components are rolled (right).



INTEGRAL tank assembly is shown in jig.

Saab Producing J35 Draken

By David A. Anderson

Linköping, Sweden—Tooling for the Saab J35 Draken was a substantial design consideration from the start, since it became known that the Swedish Air Force wanted the all-weather fighter plane in quantity. Before the prototype flew, the company was authorized to start making long lead-time material for an initial production order.

Production tool design started in March, 1955, and tool manufacturing began a few months later. Production will start through that August and in September the line begins to come

Production Tooling

About 25,000 tools will be used in J35 production, of which about one-third are machine tools.

There will be about 100 assemblies of the fixed type and about 3,000 sub-assemblies of some or less mobile types.

Saab's jig houses, which had previously been secured merely for the

manufacture of tools, were converted to machines for component fabrication. Detail production could start without waiting for all tools to be made, tools and fixtures could be used into the program when finished rather than delaying the whole program, and while this was being made.

Bentled honeycomb structure is used in the J35 wing panels. This is the company's first full-scale production use with this structure, and it has expanded what was an experimental bonding area into a production shop with pressure and an electrode.

The structural frame in the nose fuselage are rigid members, they carry the engine and wing loads. Generally they have variable flange angles and cross-sections, a tough machining job.

Saab tool engineers designed a special miller to make the nose, and the rest is now in full production.

Practically all J35 structural components, and most of its machined parts, start life 100 ft underground in a

Sub-assemblies Underground

concrete tunnel built to withstand the impact of nuclear air attack. Here its towers blasted out of the solid rock. Saab plant engineers supervised design and construction of an underground shop complete to the last detail of a "weather clock, that tells weather the temperature, wind velocity and weather on the surface.

Rail cars haul rock to be truck down a long speed ramp that curves into a running area for stock. Material is moved through the shop from there on, on surface trolleys. An elevator below the surface logs are, before of structural within a few minutes after arriving at the lower level. An underground ward suppression, excellent lighting and the well-planned shop layout give the no sensation of claustrophobia. Cranes are several heights, and most of the rough work, covering is noticeable anywhere.

Components go on to the surface from where they will enter a wood-lined production line now being slowly brought into shape. Like the Lauson

before the Draken was planned for production using a serial model of the complete factory, was detailed down to the bench work, no components. Final assembly line flow will be a two parallel lines while major sub-assemblies are built in from their area at right angles to the main line.

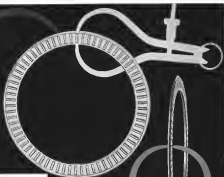
First airplanes of the line will probably not be to production standards as far as tooling goes. The J35 specifies both aspects first from the first airplane on, then shall be complete interchangeability of parts. Saab tool engineers like to emphasize "interchangeability—not replaceability."

Tooling Differences

We have a basic difference from American techniques in tooling, and that tool engineer Roland Johansson, and it is because the Saab approach a careful note mathematical constraints. That means that the master template is made in the tool shop with the aid of a cinematograph which plots the accurate line across



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ing to metropolitan tables of shops. This matter leaves the tool shop, and is the only one made.

We are Moenir and devoted wood finish a lot because of the traditional high quality of Swedish wood-working," he added. For jigs, we use a Massanaut type—the first ones developed by the Germans during the war and used later to some extent by Beppel—with clamping fixtures and cutting. Your tool engineers prefer solid construction and see that these Moenir jigs settle and you only find a lot later on supports.

"We're a little more conservative in application of design—don't care it as far as you do. And we're not more tolerant because steel costs in too soon on high-performance appliances anyway. It isn't worth the bother to make two varieties in material when we can make one."

"We have one piece any, and that is to reduce the number of people standing around hammering on metal."

Probably the biggest contributor to this goal is the Sash sub-panels, joints, which were developed to a metal work after farming and heat-treating. Most of the Sash components are formed on the sub-panel, in a two-piece construction.

Fast Techniques

Fast setting is made in the soft annealed state with a die that is a little under. Sliding blocks are used to measure the amount of material in a compression flange to get a workable fast joining. The fast operation problems a piece in which the flange region are about center and the lead line is deliberately moved to a pre-determined location.

The step, like any conventional joining of a double-headed ring, forms, for example, puts the outer flange in compression and the inner flange in tension.

After forming of the flanges to "insect" height and solution heat-treating, the part is placed in a furnace die and expressed. This step stretches the outer flange and compresses the inner one so that the stresses caused in the fast forming are counteracted in the final and opposite stresses of the second pressing.

The part comes out of the press with no distortion, but it will be almost exactly flat on a surface plate.

Another benefit, says Johnson, is the fact that a system of fast setting and so hard up drilling and welding factors. Sash bought five sets and now considers them an indispensable tooling aid. Each set includes 210 standard elements from skirted bed plates to permanent angles, all ground to an eight-mil finish. These inexpensive jigs and tools are built up without

drawing, and after being used and be free themselves, are photographed and parts listed for future reference.

Sash is thinking in terms of universal control of some of its machines using binary data. Under such a setup, if figures are read could handle them. The present machines are the most that most machines don't require the complexity of complete universal control and could be made automatic with a simple logic program. This is the line of current development work at Sash one revised index now aspects this way.

Other highlights of the Sash press tool making

• **Small size setting** in the tool press, using a British Wadsworth high-speed tooling machine with carbide cutting.

• **An carbide** are used to form the inner toolplates and other flat jigs components so that they can be made without the alignment below final firing in place. An in line at high pressure between working plates.

• **Big tubing** is used as an anvil for machining gear and shafts in the same lathe.

• **Worked hard tools** are bought by the company, unlike the practice in the U. S. Tools are periodically inspected, repaired or replaced more frequently than by an individual owner.

Johnson and other Sash tool engineers have had numerous contacts with their counterparts in the U. S. through visits and information exchanges. Most important to Sash engineers was the short time interval between airplane design and the appearance of the fast production aircraft in the U. S.

Out of this exchange has come much technical help in both directions and the Sash engineers.

Compared to current aerospace production in the U. S., Sash says its sub-

put per man-hour is about 23% higher than the best American figure known to the firm. One reason for this may be the incentive wage system adopted by the company after agreement by the union and management. The basic unit prices are established on learning curves.

Ground Testing

Functional system tests and strength checks are the major stress tests in Sash components in ground testing of their appliances. On the J15, a complete control system has been built with geometric lengths of short system tubing, dynamically correct responses and other characteristics of the system are simulated. It is in effect a hydraulic system test rig, because it also incorporates the complete landing gear with its structure, struts and brake systems as well as the elevator and rudder. This type of control simulator has been in use for more than five years, still going with the J12 Lancers.

Static strength tests are made in the same way, except that the applied loads are caused into the structure on frames attached to the frame. This gives simulated loads such as other than distributed loads such as could be obtained with tension-jack techniques. Loads are applied with the hydraulic jack, and whatever stress, and strain gauges are used for load.

Automatic hydraulic and punch loads are used. The test is carried to destruction in a few minutes.

The J15 is a TIG aircraft load simulator, and according to test engineers, it has substantial margin.

Windshields are checked for strength against load supports in a manner which shows stresses against the glass.

One of the most recent turbine rigs is a gas turbine (Torrington) device which mounts a production-type J15 fuel valve. Fuel lines on the J15 are placed fore and aft of the nozzle of gas, in the ring seat, and there was some concern over their effects on stability and controllability in pitch. With this wheel, the static automatic fuel system can be operated and fuel can be burned in full throttle while the wheel is rotating at 14,000 rpm.

Test facilities also include a climate chamber for controls in full a complete forward fuselage, but not big enough for everything as a unit to do, and an engine—also capable of producing low pressures from -9.67 to 2122 lb per sq in. The chamber can be converted to a static test altitude of about 31,500 ft.

These is a small Lanchester testing rig and the usual kinds of vibration and structural test equipment seen in most test plants.

(This is the second of two articles on the Sash J15. The first appeared in last week's issue.)



ROUNDER dimensions wing panel it being used in production of the Sash J15.



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load, so true to scale by different regions even up to heights of 150 mi. Computations of the atmosphere is not considered to present problems for the vehicle under consideration, except for none. On two occasions, clouds in the picture may occur at altitudes of 50,000 to 70,000 ft. that could cause damage by impact and erosion.

Pressure is a useful condition with its lowest static values at the highest altitudes. Static pressure, however, do not indicate the vehicle erosion level because of the effects of vehicle velocity. Dynamic pressure is a function of vehicle velocity and altitude.

Various air density is more for parts of an molecule in the atmosphere presents three types of media through which the vehicle must pass. Regions where the molecules of an atom of the vehicle are affected before striking the vehicle is known as the continuum flow region. This is considered in the altitude region below 300,000 ft. The other vehicle occurs for altitudes above approximately 500,000 ft. where the air molecules ahead of the vehicle are not affected by the vehicle until they strike the skin of the vehicle directly. This is a region where the mean free path of molecules is in the order of over 100 ft.

Region in between these two extremes, where the mean free path of molecules is in the order of 0.1 to 100 ft. is known as the slip flow region.

Dynamical effects of a high carrier on all of the four types of vehicles would be the same.

- Lackage of fluid through walls
- Absence of an damping in vibration
- Reduction of low-damping effects
- Causes discharge of air
- Possibility of explosive decomposition of pressurized vehicles

Selector Radiation

Only about two-thirds of the energy radiated by the sun reach the surface of the earth, the atmosphere is reflected outward or absorbed in the atmosphere. Value of the energy absorbed by the earth's surface at noon on a summer day, with the sun directly overhead is about 1,000 watt/cm² on the earth. At any other time of year or time of day, the energy received will be less in proportion to the cosine of the angle of the sun's elevation.

Selector radiation is used within a closed complete road until it encounters the earth's atmosphere where some wavelengths are selectively absorbed by the air's different constituents. These few, as solar radiation penetrates the atmosphere, its energy is distributed in a continuous changing as more energy is absorbed.

All wavelengths shorter than 2,500 angstroms are completely absorbed, and more than 98% of the ultraviolet be-

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SAFT-MATIC is a simple, safe, designer-oriented system, especially suited for commercial and private aircraft installation. For the first time both comfort and convenience are incorporated into a simple, complete system that provides absolute maximum safety.

The SAFT-MATIC system consists of Parflex's "Roll-Back" shoulder harness, foot with integral shoulder straps and a specially designed, slide-in leg belt and buckle. Combined, these two units allow the user to attach body leg belt and shoulder harness connectors in a matter of seconds. Both adjustments in just a simple pull on the strap ends until the desired adjustment is achieved.

When being used, the Roll-Back allows a full freedom of movement - unless an emergency should occur. Only then does the ergonomic Roll-Back take over to instantly lock and tighten the user from any force which tends to throw him from the seat - in any direction!

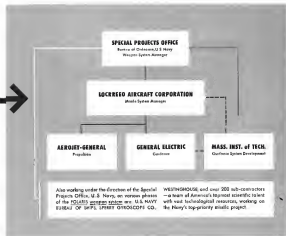
The SAFT-MATIC Buckle has a quick release feature which instantly disengages both shoulder straps and leg belt straps to an easy turn of the buckle face to either direction. The user is then free to step from the seat, and when not in use the shoulder straps hang loosely and unobtrusively.



Here, at last, is a complete system which provides complete convenience - full motion comfort - and maximum safety. SAFT-MATIC is now in production - write for complete information!



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Fourteen months ago Lockheed was appointed missile system manager of the POLARIS. The objective: to develop a solid-propellant missile with a thermonuclear warhead, which could be launched underwater from nuclear submarines to hit targets 1,500 miles away. The technological problems involved were admittedly the most complex yet encountered in the history of ballistic missile development.

Progress to date on the POLARIS has exceeded

all expectations of the U.S. Navy. Lockheed is proud to be associated with its fellow task force members and the sub-contractors developing the complete POLARIS weapon system. The brilliant contributions and spirited teamwork of these more than 200 POLARIS sub-contractors, and their dedication to our mutual goal—greater security for our nation—speeds the progress of the POLARIS missile system, prime responsibility for which is Lockheed's.

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twice 2,000 and 3,000 angstroms. Even for solar heating, only the ultra violet part of the spectrum is important for other environments such as ozone, dissociated gases and ionized gases.

In order for a photon of solar radiation to form ozone it is stated a gas it must have a certain wavelength or energy. This energy is proportional to the frequency of the light or inversely proportional to the wavelength. Thus, at each reaction of the environment there is a necessary wavelength of light which will be effective.

Longer wavelengths, no matter what their intensity, will not cause the reaction, although they will heat the medium and the higher temperature would cause an increase in the reaction rate.

A ionized light vehicle or boost glide vehicle would be flying between 100,000 and 300,000 ft. and would be exposed primarily to 2,000 to 3,000 angstrom solar radiation and to some X-rays. A ballistic vehicle because of its short time of travel would not be damaged by solar radiation.

A satellite, at greater than 1,000,000 ft. altitude, would be subjected to all the solar radiation. Except for some isolated portions, there is a large part of the ultraviolet spectrum for which there is an unpaired knowledge concerning effects on materials other than metals, which will absorb them.

Ozone Concentration

As an environment, the important characteristics of ozone are its concentration, location and chemical reactivity. Peak concentration of ozone in the atmosphere mainly is through the 55,000 to 60,000 ft. altitudes, where the maximum concentration is about 10 parts per million of air.

Maximum concentration does not change much with greater total values of ozone but instead the ozone layer becomes thicker and the same high concentration is likely to occur for a greater range of altitudes.

Energy required for the formation of ozone in the atmosphere comes from ultraviolet radiation. Damaging effects of ozone are due to its ability to its chemical reactivity, for example with organic materials such as rubber under stress. Ozone reacts readily with unsaturated organic compounds, adding all their oxygen atoms at a double or triple bond.

Residual compounds are "oxidized." Decomposition of oxides results in oxides at the position of the double bond and, subsequently, in the formation of acids, aldehydes and ketones.

Ozone is also harmful to humans. At sensitive persons, two parts per million will cause severe lung irritation in

less than an hour. At eight parts per million, breathing apparatus is not safe in American air and the lungs begin to fill with fluid.

Both ionized light vehicles and boost glide vehicles will be subjected to the effects of ozone, while ballistic vehicles will not. One possibility for ionized vehicles is that ozone can be made to decompose entirely by subjecting it to high temperatures (above 200C.) before the air combining in it brought into the vehicle.

Dissociated Gases

Between 200,000 and 300,000 ft. a transition occurs in the composition of the atmosphere with oxygen supposedly being 90% molecular (O₂) at 250,000 ft. and nearly 100% atomic (O) at 300,000 ft. Heights and relative concentrations have been developed theoretically.

Theory on the formation of atomic nitrogen is based on atomic spectra. Atomic nitrogen is believed to be produced at heights of 425,000 to 600,000 ft. with the maximum rate of production at 525,000.

Only vehicle that will be affected by these dissociated gases is the satellite. Metals which form an adherent oxide film may not form a thicker film and at a faster rate in oxygen, for example, aluminum. Atomic oxygen will react with such metals as iron, copper and silver, and with many organic materials, especially those with double bonds. Atomic nitrogen does not react much with metals except under very high temperatures.

Atomic ozone most frequently at greenhouse heights of 70 deg. each, stretching from about 300,000 to 600,000 ft. altitude. The lower edge can be sharply defined and its mole is 500,000 ft. but it ranges from 250,000 to 475,000 ft.

All forms of atomic such as quartz, glass, ceramics, and all forms of steel at short duration, lasting from seconds up to half an hour. More than 100 wavelengths of ultraviolet spectra of the ozone are known, with different forms of the ozone varying in intensity of certain spectral lines.

It is commonly accepted that the primary cause of both ozone and magnetic storms is cosmical radiation emitted by the sun. These electrically charged particles are diverted toward the geomagnetic poles by the earth's magnetic field.

Only the satellite vehicle would be subjected to the above part of the storm, going through the usual several thicknesses of 300 mi. would require about 60 sec. A satellite passing over both poles would be in the severe storm region for less than 5% of the time.

Effect of passing through the storm would be that the satellite would be subjected to weak X rays that would not

penetrate metal skins of moderate thickness.

In addition to its both height and density of ionized gas layers also based on radio signal reflections and radio magnetic fields. If a system of radio signals from one to 10 megacycles is used, the signals will not be affected at different times depending on the different heights) which vary with the frequency where time increases directly with frequency.

There are numerous theories regarding the cause of ionized gas layers. Some of the possibilities have been formulated from information obtained from both the reflection and refraction of radio techniques.

Electrons and ions making up these layers would have only thermal energies; their velocity would be too low to cause ionization. Their primary effect would be electrical, interfering with or reflecting radio signals being sent to or from the vehicle.

Solid Particles

Metals and meteorites are only part of the solid particle environment. In addition, it is important to consider meteoric debris whose relative velocity in the atmosphere is zero.

All of these particles are believed to be in orbit about the sun, although one even holds that the orbit may be beyond the radius from chemical. Cosmic dust, originating from interstellar space, is considered to be distributed uniformly throughout space in the earth's orbit.

Atomic solid particles that would strike a vehicle, causing damage by penetration or erosion, is considered to be one of the major environmental quantities.

A meteor weighing one megagram will penetrate aluminum skins of satellite or space ships up to one millimeter thick. Smaller and less energetic meteorites will not penetrate but instead go out small pieces of skin at a range useful to investigators.

In addition to the physical damage resulting from such collisions, some effect will also be to change the density of the skin which will be important in maintaining temperature equilibrium in the vehicle.

Effects on ionized light or boost glide vehicles will be simple absorption of the skin. Ballistic vehicles will be exposed for much a short time that the effect is negligible.

Satellites will operate at altitudes where they will collide only with high velocity particles. These will be continuous stream of particles heavy enough to penetrate the skin.

Maximum value of the constant has metal component of the earth's mag-

netic field is at the magnetic equator. It is 0.3 gauss. North-south part of the field strength is considered to be caused by the earth's internal structure.

The source for the ionizing field is assumed to be a group of these magnetic currents existing in the atmosphere around the earth. These magnetic currents are supposed to consist of several thousands moving with a constant velocity of about 50 ft. at the height of the lower atmosphere.

Ons Firm Value

The only firm value of the environment is the proportionality of the strength of the earth's magnetic field to the pole of the distance from the center of the earth. This value holds to 300,000 ft. The supposed presence of gas currents between 350,000 and 500,000 ft. would cause a group in the magnetic field value at these altitudes, so that the existence of a constant-altitude magnetic field at altitudes above 300,000 ft. is unlikely.

The earth's deleterious effect of the earth's magnetic field might be due to 2.5 sec. gamma rays from the sun and being directed toward the growing point by the magnetic field. One the satellite vehicle would be subjected to this type of bombardment—not the other vehicle types.

Protons with an energy of 2.5 sec are absorbed by about four radians of air at normal temperature and pressure. Because the stopping power of aluminum is only about 1.25 times that of air, these protons would penetrate satellites above 300,000 ft.

This is the second of two articles describing hyper environments that deal with and discuss environmental conditions found at altitudes varying from the present operational ceiling of about 75,000 ft. to interplanetary space. In second environment, there created by the operation of aircraft or missiles or by their interaction with the natural environment, were the subject of the first article.)

FILTER CENTER

►Fully Computed Gen-Low will develop new actual gas for Navy Bureau of Aeronautics investigating full acceleration compensation about both pitch and roll axes, using modification of technology employed in Navy-Kolls tropo-compensated gyro (AW Feb 10, p. 39). To provide full time compensation at all aircraft speeds, gyro motor will be powered from a variable frequency source whose frequency is varied in a direct function of induced speed or ground speed, obtained from a Doppler radar system.

►Hollman Proven Vanguard-Silence coils used to power one of Van guard's two radio transmitters was manufactured by Hollman Electronics Corp. Vanguard's nine coils have efficiency of about 12%, compare with



Firebreaks Travel With Mk. 7 Javelin

Mk. 7 Glider Bombs, latest modification of current Glider Air-to-Air Rocket, carry two to four firebreaks instead of one, each carrying 37 in. guided air-to-air rockets, and two 50 mm. Army cannon. Mk. 7 will go into service with RAF Fighter Command later this year, will probably become command's main strength. Plans is powered by two Aero-Solider Supersonic rated at 13,000 ft. thrust each. Altitudes are being developed for three performance in the model and the Javelin Mk. 6, featuring a section of maneuvering pilot and wing leading edge mounted outboard at high speeds.



Republic Aims Alouette at Civil Market

By Eirela J. Bolkan

New York—Foundation for a long-range program of rotary wing aircraft design, sales and service aimed primarily at serving commercial requirements is being built by Republic Aviation Corp.'s newly formed Helicopter Division.

"We are not forgetting the military, but the thing has to go on the basis of cooperation with commercial helicopter operators," Herbert Mance, manager of the division explained to *AVIATION WEEK*.

Police, which has complete support of Republic top management, will be its star client of projects. Indeed, presently its military requirements, tactical and strategic, on the basis of off-the-shelf availability, with the military paying for an extra that it requires. Management's feeling is that a large portion of the present high cost of commercial helicopters can be directly traced to high overhead required to support military requirements in facilities, research and development and testing, contractual agencies. Design, off-again contract-letting and conflicts are also cited as cost builders.

Management Team

In setting up its new division, Republic gathered a management nucleus having considerable rotary wing background. Lineup includes:

- General Manager Herbert Mance, former assistant vice president of Bell Helicopter Corp. and with that company some 15 years.
 - Sales Manager and assistant to the division manager, Gerald R. Benish, former regional sales manager for Continental Aviation's Turbine Division, which has manufacturing rights in U.S. for Turbomec engines.
 - Director of Commercial Sales Fred H. Keller, former executive vice president of Bell Helicopter, Ft. Worth, and supervisor of commercial sales for Bell.
 - Director of Engineering William E. Calver, former president of Transcontinental Aircraft Corp.
 - Chief Pilot Paul Mason, former Bell Helicopter pilot.
 - Field Service Manager Joseph Guard, formerly with Vertol Aircraft Co.
- Initially, design and production of its own helicopters does not seem to be the division's current planning—plus simply is to maintain line enriched, with present emphasis on sales and



CARGO SLING operation is performed by one of Republic's two Alouette II demonstration helicopters. These 150-hp Alouette machines, deliveries are made with 400-hp engines.



ASSEMBLY LINE in Republic's Helicopter Division factory shows both the Alouette II and the new model in use No. 1800. Basic price is U.S. \$150,000.

service and then work up to production when demand is justified.

What will the products come from? Based on the type of operations envisaged by the division is its recent acquisition of sole distributor rights in North and Central America of French Sud Aviation Alouette II (Bell) helicopter-powered five-seater. Over a year ago, Republic Aviation set up the initial parameters for a sales and eventual

production licensing agreement with Sud, since sponsored a nationwide \$1-400,000 tour of two of the helicopters (AVW Mar 6, 1975, p. 30).

Favorable comment arising from these demonstrations led the company to renegotiate the agreement and work on terms late last year.

Currently, it is an off-the-shelf disassembled Sud-built Alouette II in the United States, has brought in a dozen

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EDWARD M. "Bud" FLEHM, Senior Project Engineer of the F-101 Voodoo airplane, has been in charge of the design and development of these Air Force fighters since their inception. Bud's abiding faith in his engineering team and in the Voodoo itself, has been a dominant influence toward the success of this project. A native son, graduate of Missouri University, he joined the McDonnell organization in 1944.

Range and reliability, two outstanding performance features of the F-101 Voodoo, were demonstrably demonstrated during "Operation Sun Run," when three new transcontinental speed records were established. The world-wide acclaim of the Voodoo which followed was a fitting tribute to the many McDonnell teamsters, engineers and others, who contributed their skills in creating and developing this fine airplane.

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Piper Research, Test Center

New 10,000 sq ft engineering building is first east of Piper Aircraft Corp.'s Alaska development center at Vero Beach, Fla. Center will concentrate on new features and utilize structural design. Flight tests will also be handled here. Center will permit atmosphere free of the today factor problems which drastically handicapped previous development projects of Lockheed, the manufacturer. Other features of Field 4. Track, today's actual program is development of a new low-cost agricultural airplane. Piper today also will maintain engineering program.

area, helicopter equipped at 16,500 ft pressure altitude (16,500 ft) density altitude) carrying a pilot, passenger, radio equipment, weapons. One ship loaded on 14,200 ft Mt. Evans, Colo., carrying a passenger, while another Alouette hovered above it carrying three people and camera equipment to record the event. Republic engineers a typical oil all share mission for the Alouette carrying four people and pilot 75 mi. and return with 10-min. fuel reserve.

Compare it with the installation of a jump seat between the two front seats, which would provide oxygen capacity on short missions.

To illustrate close relations with the French manufacturer, Republic announced a liaison representative in St.

Aviation plant, as Sted does at the U.S. manufacturer's facility. In addition the firm is able to call on Republic International's Paris office.

Availability of parts from France is very good. Munter told American WPA, which is an example, how the Alouette had helicopter for development for an off-peak manufacturer. It was Sted manufactured there) on a Friday and received the requested material on the following Tuesday.

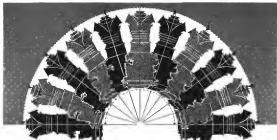
Compare it now working on a powerplant exchange program to ease overhaul problems and expects to have this ready in a few weeks.

With sales program underway, next step being placed in smaller general component manufacture here toward



Monte-Copter Makes Tethered Flight

Prototype prototype Monte-Copter is shown during recent test flight at Boeing Field, Seattle, Wash. (NW Mar 18, p. 15). Helicopter now has two Coast Guard rescue hoisting 140 in. hoisting cable, later version is planned for a single 280 in. cable. Finished craft will also have wings to provide additional lift and reduced rotor during high speed forward flight and will also incorporate a fiberglass reinforced plastic fuselage to permit amphibious operations. Munter L. Kornee, product manager (right) reports



DESIGNERS WELCOME THE NAPIER GAZELLE

**'Any angle' installation
gives greater freedom**

Napier's Gazelle offers a welcome break to "fired" turbo-propeller drives. The master free-turbine engine can be mounted on single support in the helicopter structure UPRIGHT, HORIZONTALLY, OR IN ANY POSITION IN BETWEEN.

This "any angle" installation relieves the designer of many accepted limitations. It also gives him more opportunity to make proper use of fuselage space—valuable space which should, after all, be used for payload accommodation.

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The Gazelle has an impressive power output of 1,200 h.p. It is now well on the way to developing 2,000 h.p. for a weight of 900 lbs.—a ratio of 0.65 h.p. per engine for good fuel economy, cooling fans, etc. The free turbine arrangement keeps loads off the weight of the turbo-shaft mechanism.

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The design of the Gazelle provides a design of dual fuel-injection pumps. Available from short-period emergency power outputs up to 20% above the normal maximum. Helicopters demand thrust, reliable response. The Gazelle is designed for strenuous duty and long service before overhauls. Just what



The Bristol 100—shown by the Royal Air Force—is powered by two Gazelles.

the time for overhaul open, unattended steady maintenance is assured by the Gazelle's essential simplicity and the built-in ease with which it is built.

REPAIRS BY REPLACEMENT

This principle means that Gazelle components and assemblies are interchangeable—and repair becomes a straightforward task. The turbine, compressor turbine and compressor system, compressor and accessories must be replaced as one—undoubtedly, particularly correct assembly. The turbine case cooling water seal also is replaced as a straight unit with neither any other adjustments.

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goal of building the entire aircraft in the U.S.

Among end-stage components will be the Alouette's dual-type landing gear mechanism (some contractors in early deliveries use French), and rotor blades. Cisagroup has been talking to possible suppliers of latter ones, has not yet made a selection.

Helicopter Division is expected so fast it will be able to tap the parent company's resources when needed, getting her work done. As Marney explained it, if the division needs a turbine, it will be able to get one through Republic, since gas for construction with the corporation's experience, one of its research facilities and area assignment of production or assembly line personnel.

In this way, the division, operating under its own budget, will be able to make most economical use of available resources, requiring a minimum of its own equipment and personnel—both looking for economies with increase in business. This situation of temporary site personnel and equipment also benefits the parent corporation in reducing cost of these overhead items.

But this relationship does not make the division wholly dependent upon the parent corporation for services. For example, as it gets into manufacturing phase, it plans to allocate jobs on a bid basis, with the parent corporation being considered as a vendor which will be to supply quantities on an as-needed basis in competition with others.

Product improvement

Helicopter Division also is planning a good and improved program as the Alouette, which will be based on keeping the cost suitable to operator's requirements based on continued service and discussion with the military. Division is looking a great deal of experience to work on the development program.

Alouette apparently will not be a one-shot project. At Fort Belvoir, thinking is to handle a line of civil helicopters. Engineering staff will be primarily responsible for working out design problems based on sales organization's contacts with the military. They will work with an established manufacturer in supplying his product to one that the public can add to its line. Philosophy will be not simply to sell a foreign product here, but instead to market a foreign designed product developed to needs in this hemisphere.

High utility of the turbo-powered Alouette compared with comparable size available equipment was cited as reason Avco Helicopters decided on getting into this new equipment. Avco Manager Robert E. Tumble noted that he will be able to cover twice the payload he now carries in one of the firm's three Bells (two 47Gs and one 47G-3).

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at a much higher speed—50 mph (one speed to about 360 mph).
Both of J&H's operations in North Carolina and Oregon is working with the U.S. Forest Service on fire fighting, bordering among road surveying, timber and upland soils preservation, forest management equipment is not permitted to enter and carrying administrative personnel.

Trinkle estimated that the operation puts in some 500 hr annually on its jobs, operating at altitudes ranging from about 5,000 ft to 7,000 ft.

On fire fighting missions, J&H's job is primarily to get men and material into position for combating wildfires—fire has burned over 100 acres and their equipment in one day into some acres. During serious blazes, additional gas used up, company has flown 190 hr in 17 days since Trinkle put in 131 hr in a single 24-hr period on such missions.

Helicopters at least double the effectiveness of Forest Service fire fighters, men would line at least a day in walking out of some of the areas and the helicopters get them to the scene in 15 min to 45 min.

An important part in this type of operation is keeping use of the vehicle to a minimum. Thus, J&H units provide means closer to landing positions. Trinkle noted that the Alouette is smaller than the Bell 47, its entry door measures 75 ft, compared with 35 ft 6 in. for the Alouette. In contrast a difference of just a couple of feet would double landing people another mile or two area from their selected drop, requiring a hole through heavy brush with a pick.

Some estimates that for the Alouette it will have to charge just a little more than double the rate for its Bell, which is approximately 5100-in. base, at the start and it develops out experience. Even at the figure, the highest efficiency of the new drop is expected to make it a profitable venture.

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Lacrosse Silver Special, in production at Ft. Collins, Colo., will sell for \$5,995. Features include: optional equipment offered includes: swing flap, 540, wheel pump, 5413, suspension lights 5412, 541, landing lights, 5412, pump unit, 5417 and Turbo Supercharger with unit, 5413.

Requirement for lines is standard equipment for aircraft carrying passengers on far last at night has been secured by Civil Aeronautics Administration in Amendment 45.5 which makes this more optional. Requirement for this addition on long-distance flights still holds.



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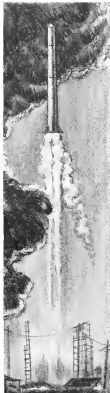
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AVIATION WEEK March 31, 1994

Motors Matched Power Team of Allison Prop-Jet Engines and Aero products Turbo-Propellers Brings Flight-Proved Jet-Age Power to Airlines of the World in The New Lockheed Electra



ELEVEN AIRLINES CHOOSE ALLISON PROP-JET POWER. The flexibility of Allison Prop-Jet power enables the Lockheed Electra to solve major problems facing the airline transportation industry—bringing jet-age speeds and comfort to medium- and short-range flights *economically*. These flights make up more than 90% of all air travel. The Electra, with its four Allison Prop-Jet engines and Aero products Turbo-propellers developing a total of 15,000 horsepower, can operate from existing airports *quietly* and *efficiently* under present air traffic control patterns. Electra purchases totaling \$300,000,000 have been placed by 11 world airlines—a demonstration of their confidence in the ability of this luxurious airliner to fulfill its mission for air travelers everywhere.

ALLISON DIVISION OF GENERAL MOTORS, Indianapolis, Indiana



ALLISON PROP-JET POWER